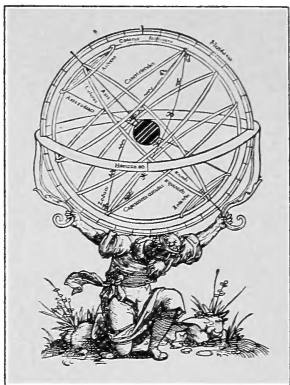


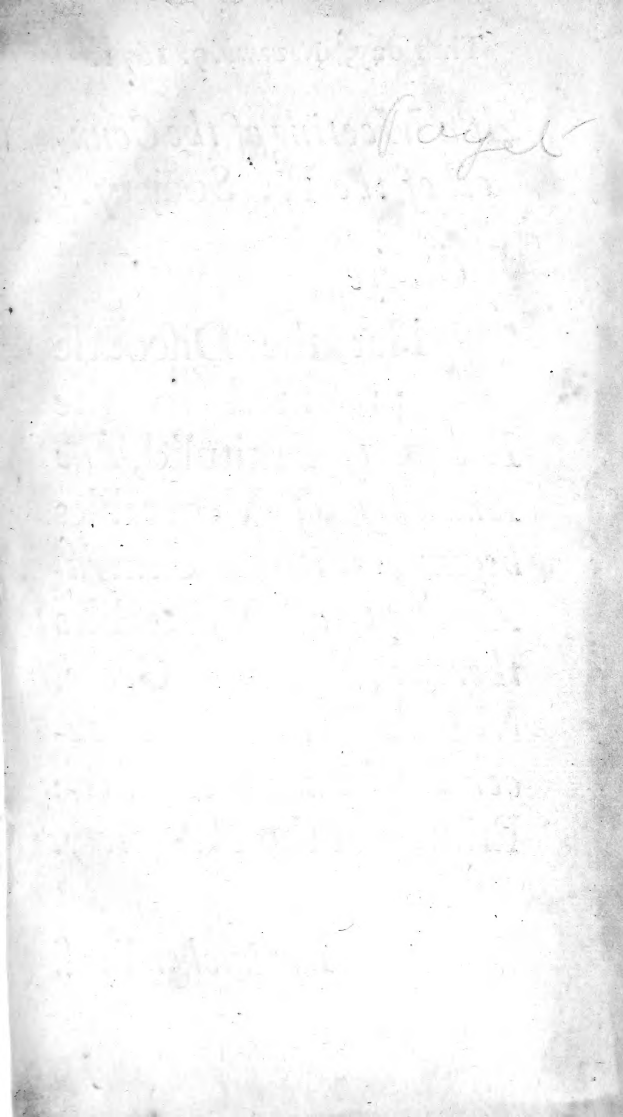
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Thursday, Novemb. 9. 1671.

At a Meeting of the Council of the R. Society.

Ordered,

THat the Discourse presented to the R. Society, Entitul'd, *The Anatomy of Vegetables begun, with a General Accompt of Vegetables thereon*, By N. Grew, M.D. be Printed by Spencer Hickman, one of the Printers of the R. Society.

Brouncker Pres.

THE
ANATOMY
OF
VEGETABLES
Hugh Begun. *Dickson*
With a
GENERAL ACCOUNT
OF
VEGETATION
Founded thereon.

By NEHEMIAH GREW, M. D.
and Fellow of the *Royal Society*.

L O N D O N,

Printed for *Spencer Hickman*, Prin-
ter to the *R. Society*, at the *Rose*
in *S. Pauls Church-Yard*, 1672.

THE
ANATOMY
OF
VEGETABLES

Bound.

1718

GEORGE B. B. B.

OF

VEGETABLES

AND

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OF

THE

OF

OF

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OF

41
G83X
1672
SCD1A3
TO THE

Right Honourable

&

Most Illustrious

THE

PRESIDENT & FELLOWS

OF THE

ROYAL SOCIETY,

The Following

DISCOURSE

Is most Humbly

Presented

By

The Authour

NEHEMIAH GREW.

A 3

TO

TO THE

Right Honorable

THE LORDS

OF THE PRIVY COUNCIL



TO THE

Right Reverend

J O H N

Lord Bishop of

C H E S T E R.

MY LORD,

I hope your pardon,
if while you are
holding *that Best of*
Books in one Hand, I here
present some Pages of
A 4 that

The Epistle

that of *Nature* into your other: Especially since *your Lordship* knoweth very well, how excellent a *Commentary* This is on the *Former*; by which, in part God reads the *World* his own *Definition*, and their *Duty* to him.

But if this Address, *my Lord*, may be thought congruous, 'tis yet more just; and that I should let *your Lordship*, and others know, how much, and

how
131

Dedictory.

how deservedly I resent
your extraordinary Fa-
vours: Particularly that
you were pleased so far
to animate my Endea-
vours towards the pub-
lishing the following *Ob-
servations*. Many where-
of, and most belonging
to the First Chapter, ha-
ving now lain dormant
near seven years; and yet
might perhaps have so
continued, had not *your*
Lordships Eye at length
created

The Epistle

created Light upon them.
In doing which, you have
given one, amongst those
many Tokens, of as well
your readiness to promote
learning and knowledge
by the hands of others;
as your high Abilities to
do it by your own; Both
which are so manifest in
your Lordship, that like
the first Principles of *Ma-*
thematical Science, they
are not so much to be as-
serted, because known
and

Dedictory.

and granted by all.

The Consideration
whereof, *my Lord*, may
make me not only *just* in
owning of your Favours,
but also most *Ambitious*
of your *Patronage*: which
yet to bespeak, I must con-
fess I cannot well. Not
that I think what is good
and valuable, is alwaies its
own best Advocate; for
I know that the Censures
of men are humorous and
variable, and that one
Age

The Epistle

Age must have leave to frown on those Books, which another will do nothing less than kiss and embrace. But chiefly for this Reason, lest I should so much as seem desirous of *your Lordships* Solliciting my Cause as to all I have said: For as it is your Glory, that you like not so to shine, as to put out the least Star; so were it to your Dishonour to borrow your Name

Dedicatory.

Name to illustrate the
Spots, though of the
most conspicuous.

Your Lordships

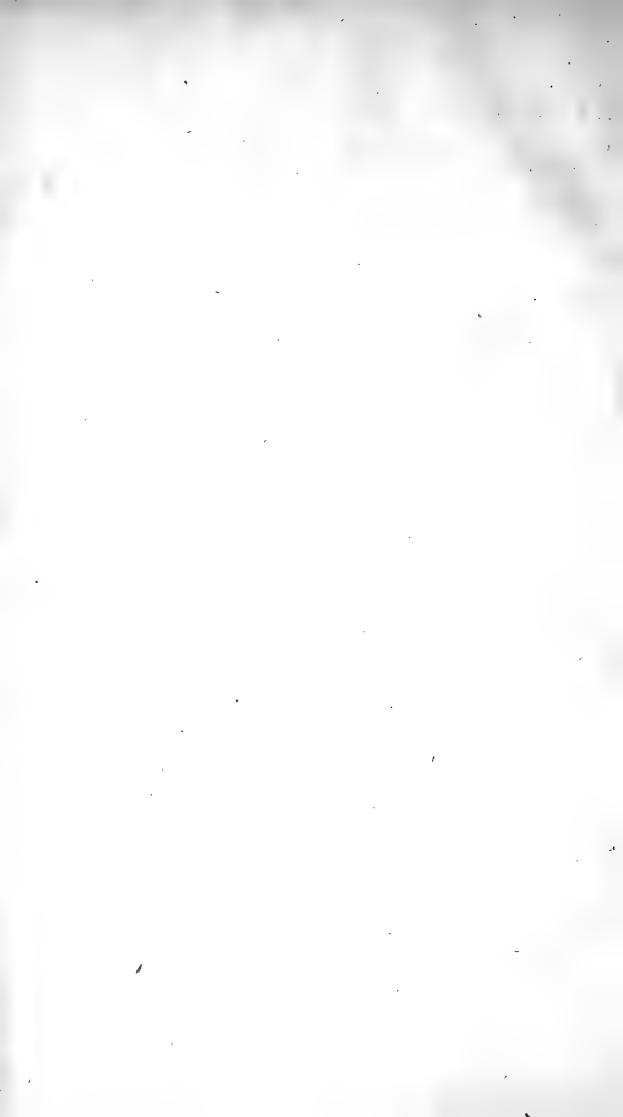
Most Obliged

&

Most Humble

Servant

Nebemiah Grew.





THE PREFACE.



What antiquity the Anatomy of Animals is, and how great have been its Improvements of later years, is well known. That of Vegetables is a Subject which from all Ages to this day hath not only lain by uncultivated; but for ought I know, except some Observations of some of our own Countrey-men, hath not been so much
as

as thought upon ; whether for that the World hath been more enamoured with the former, or pity to humane frailty hath more obliged to it, or other Reasons, I need not enquire.

But considering that both came at first out of the same Hand, and are therefore the Contrivances of the same Wisdom ; I thence fully assured my self, that it could not be a vain Design, though possibly unsuccessful, to seek it in both.

In the prosecution hereof, how far I have gone, I neither judge my self, nor leave it to any one else to do it ; because no man knows how far we have yet to go, or are capable of going. Nor is there any thing which starves and stinteth the growth of knowledge more, than such Determinations, whether we speak or conceit them only.

What we have performed thus far, lieth, for the most part, open to the
use

The Preface.

use and improvement of all men. Only in some places, and chiefly in the Third Chapter, we have taken in the help of Glasses; wherein, after we had finished the whole Composure, some Observations made by that Ingenious and Learned Person Mr. Hook, a Worthy Member of the Royal Society, my much Honoured Friend, and by him communicated to me, were super-added: As likewise some others also Microscopical, of my own, which his gave me the occasion of making.

Those that shall think fit to examine, as well as to peruse these Observations, we advertise them, First, That they begin, and so proceed till they end again, with the Seed: For they will hardly be able to avoid Error and Misapprehension, if either partial or preposterous in their Enquiries. Next, That they confine

2

not

The Preface.

not their Enquiries to one time of the Year ; but to make them in several Seasons, wherein the Parts of a Vegetable may be seen in their several Estates. And then , That they neglect not the comparative Anatomy ; for as some things are better seen in one estate, so in one Vegetable, than another.

What, upon Observation already made, we have erected, as they are not Sticks and Straws ; so neither do we assure all to be of the best Oak. How Dogmatical soever my Assertions may seem to be, yet do I not affect the unreasonable Tyranny of obtruding upon the Faith of any. He that speaketh Reason, may be rather satisfied, in being understood, than believed.

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Cl.

Cl. Glissonius in Prolegomenis præfixis Libro de Hepatis Anatomia, c. 1.

Plantæ quoque in hunc censum (*sc. Anatomicum*) veniunt. Varia enim partium textura, & differentiis constant: & proculdubio ex accurata earundem dissectione, utiles valde Observationes nobis exurgerent; præstaretq; in illis (*inferioris licet ordinis*) rebus examinandis operam impendere,

re, quam in transcribendis
(ut sæpe fit) aliorum la-
boribus, inutiliter ætatem
transigere. Quippe, hoc
pacto, ignavarum apum
more, aliena duntaxat al-
vearia expilamus, nihilq;
bono publico adjicimus.

To be added and corrected.

PAg. 8. l. 15. after *must*, *adde* upon the
Sprouting of the *Bean*. p. 12. l.
23. after *dense*, *adde* and thence their dif-
ferent Tinctures. p. 18. l. 13. after *that*,
adde when. p. 20. l. 8. for *the*, read *an*.
p. 56, l. 8. r. once. p. 90. l. 11. *dele* *as*.
p. 91. l. 12. r. older. p. 120. l. 11. after
all, r. *is*. p. 134. l. 11. r. *Convolvulus*.
p. 143. l. 10. r. *ever*. p. 145. l. 14. for
not, r. *or*. p. 159. l. 8. for *by*, r. *to*. p. 160.
l. 18. *dele* *not*. p. 185. l. 14. after *there-*
with, r. *the*. *dele* the former *the*.

In some Copies.

P. 168. l. 4. r. *ultimate end*, and p. 170.
l. 22. r. *Favours*.

The Reader is desired to excuse the mispla-
cing of the Figures by the Graver, in the
Authors absence.

THE
ANATOMY
OF
VEGETABLES
Begun.

With a General Account of *Ve-*
getation founded thereon.

CHAP. I.

Of the Seed as Vegetating.



Eing to speak of Vegeta-
bles; and, as far as In-
spection and consequent
Reason may conduct, to
enquire into the visible Constitu-
tions and Uses of their several
/ B 6 Parts;

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Parts ; I chuse that Method which may with best advantage suit to what we have to say hereon : And that is the Method of Nature her self, in her continued Series of Vegetations, proceeding from the Seed sown, to the formation of the Root, Trunk, Branch, Leaf, Flower, Fruit, and last of all, of the Seed also to be sown again ; all which we shall in the same order particularly speak of.

The Essential Constitutions of the said Parts are in all Vegetables the same : But for Observation, some are more convenient ; in which I shall chiefly instance. And first of all, for the Seed we chuse the great Garden-Bean.

If we take a Bean then and dissect it, we shall find it cloathed with a double Vest or Coat : These Coats, while the Bean is yet green, are separable, and easily distinguished. When 'tis dry,
they

of Vegetables. 3

they cleave so closely together, that the Eye, not before instructed, will judge them but one; the inner Coat likewise (which is of the most rare contexture) so far shrinking up, as to seem only the roughness of the outer, somewhat resembling Wafers under *Maqua-rooms*.

At the thicker end of the Bean, in the outer Coat, a very small *Foramen* presents it self: In dissection 'tis found to terminate against the point of that part which I call the *Radicle*, whereof I shall presently speak. It is of that capacity as to admit a small Virginal Wyer, and is most conspicuous in a green Bean.

This *Foramen* may be observed not only in the great Garden-Bean, but likewise in the other kinds; in the French-Bean very plainly; in Pease, Lupines, Vetches, Lentiles, and other Pulse 'tis also found: and

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in many Seeds not reckoned of this kindred, as in that of *Fænnugreek*, *Medica Tornata*, *Goats-Rue*, and others: In many of which, 'tis so very small, as scarcely, without the help of Glasses to be discovered; and in some, not without cutting off part of the Seed besides, which otherwise would intercept the sight hereof; it being in these and such like Seeds, from the place of the breaking off of the Peduncle perfectly distinct.

We may then observe, that all Seeds which have thick or hard Coats, have the same likewise perforated, in this, or some other manner. And accordingly, although the Coats of such Seeds as are lodg'd in Shells or Stones, being thin, are not visibly perforated; yet the Stones and Shells themselves always are; as *Chap. 7.* shall be seen how. To which Chapter, what is farther observable, either

as to the nature, or number of the covers of the Seed, I also refer.

The Coats of the Bean being stripp'd off, the proper Seed shews it self. The parts whereof it is constituted, are three; *sc.* the main Body, and two other appendant to it, which we may call the three Organical parts of the Bean.

The main Body is not one entire piece, but alwaies divided lengthwise into two halves or Lobes, which are both joyn'd together at the Basis of the Bean. These Lobes in dry Beans, are but difficultly separated or observ'd; but in young ones, especially boil'd, they easily slip asunder. See *Fig. I.*

Some very few Seeds are divided, not into two Lobes, but more; as that of *Cresses*; and some not at all divided, but entire; as *Corn*: Excepting which few, all other Seeds, even the smallest are divided, like as the Bean, into

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just two Lobes: whereof, though in most Seeds we cannot by dissection be inform'd; yet otherwise we easily may as shall be seen.

At the Basis of the Bean, the two other Organical parts stand appendent; by mediation whereof the two Lobes meet and join together. The greater of these two parts stands without the two Lobes, and upon divesting the Bean of its Coats, is immediately visible. 'Tis of a whiter colour, and more glossie than the main Body, especially when the Bean is young. In the Bean, and many other Seeds, 'tis situated somewhat above the thicker end, as you hold the Bean in its most proper posture for growth. In Oak-Kernels, which we call Acorns, Apple-Kernels, Almonds, and many other Seeds, it stands prominent just from the end; the Basis and the end being
in

of Vegetables. 7

in these the same, but in the Bean divers. See *Fig. 1.*

This part is not only in the Bean, and the Seeds above mentioned ; but in all others : being that which upon the Vegetation of the Seed, becomes the Root of the Plant ; which therefore I call the *Radicle* : by which, I mean the Materials, abating the Formality, of a Root. 'Tis not easie to be observed, saving in some few Seeds, amongst which, that of the Bean is the most fair and ample of all I have seen ; but that of some other Seeds, is, in proportion, greater ; as of *Fænugreek*, which is almost as big as one of its Lobes.

The lesser of the two said Appendents lies occult between the two Lobes of the Bean, by separation whereof only it is to be seen. 'Tis enclos'd in two small Cavities form'd in the Lobes for its reception. Its colour comes near that of

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the *Radicle* ; and is founded upon the Basis thereof, having a quite contrary production, *ſc.* towards the cone of the Bean ; and being that very part, which, in proceſs, becomes the Body or Trunk of the Vegetable. See *Fig. 1.*

For the ſake of this Part principally it is, that the Bean is divided into Lobes ; *ſc.* that it may be warmly and ſafely lodged up between them ; and ſo ſecur'd from the Injuries ſo tender a Part would ſuſtain from the Mould , whereto, had the Main Body been entire, it muſt have lain contiguous.

This Part is not, like the *Radicle* , an entire Body, but divided at its looſe end into divers pieces, all very cloſe ſet together, as Feathers in a Bunch ; for which reaſon it may be called the *Plume*. They are ſo cloſe, that only two or three of the outmoſt are at firſt ſeen : but upon a nice and curious ſeparation

of Vegetables. 9

separation of these, the more interior still may be discovered. Now as the *Plume* is that Part which becomes the Trunk of the Plant, so these pieces are so many true, and already formed, though not displayed, Leaves, intended for the said Trunk, and foulded up in the same plicature, wherein, upon the sprouting of the Bean, they afterwards appear. In a French Bean the two outmost are very fair and elegant. In the great Garden-Bean, two extraordinary small Plumes, often, if not always, stand one on either side the great one now describ'd: From which, in that they differ in nothing save in their size, I therefore only here just take notice of them. And these three Parts, *sc.* the *Main Body*, the *Radicle*, and the *Plume*, are concurrent to the making up of every Seed; and no more than these.

Having thus taken a view of the
Orga-

10 The Anatomy

Organical Parts of the Bean, let us next examine the Similary, *sc.* those whereof the Organical are compos'd: a distinct observation of which, for a clear understanding of the Vegetation of the Seed, and of the whole Plant arising thence, is requisite: To obtain which, we must proceed in our Anatomy.

Dissecting a Bean then, the first Part occurring is its Cuticle. The Eye and first Thoughts suggest it to be only a more dense and glossy Superficies; but better enquiry discovers it a real Cuticle. 'Tis so exquisitely thin, and for the most part so firmly continuous with the Body of the Bean, that it cannot, except in some small Rag, be distinctly seen; which, by carrying your Knife superficially into the Bean, and then very gently bearing upward what you have cut, will separate and shew it self transparent.

parent. This Cuticle is not only spread upon the Convex of the Lobes, but also on their Flats, where they are contiguous, extending it self likewise upon both the *Radicle* and *Plume*, and so over the whole Bean.

This Part, though it be so far common with the Coats of the Bean, as to be like those, an Integument; yet are we in a quite different Notion to conceive of it: For whereas the Coats upon setting the Bean, do only administer the Sap, and, as being superseded from their Office, then die; as shall be seen: this, on the contrary, with the Organical Parts of the Bean, is nourished, augmented, and by a real Vegetation co-extended.

Next to the Cuticle, we come to the *Parenchyma* it self; the Part throughout which *the inner Body*, whereof we shall speak anon, is disseminated; for which reason

I call it the *Parenchyma*. The Surface hereof is somewhat dense, but inwardly 'tis more porous, and of a laxer Contexture. If you view it in a Microscope, it hath some similitude to the Pith, while sappy, in the Roots and Trunks of Plants; and that for good reason, as in *Ch.* 2. shall be seen, This is best seen in green Beans. See *Fig.* 2.

This Part would seem by its colour to be peculiar to the Lobes of the Bean; but as is the Cuticle, so is this also, common both to the *Radicle* and *Plume*; that is, the *Parenchyma* of the Bean, as to its essential substance, is the same in all three. The reason why the colour of the *Plume*, and especially of the *Radicle*, which is white, is so different from that of the Lobes, may chiefly depend upon their being more compact and dense. And therefore the Lobes themselves, which are green while the Bean is young;

young; yet being old and dry, become whitish too. And in many other Seeds, as Acorns, Almonds, the Kernels of Apples, Plums, Nuts, &c. the Lobes, even fresh and young, are pure white as the Radicle it self.

But although the *Parenchyma* be common, as is said, to all the Organical Parts; yet in very differing proportions. In the *Plume*, where it is proportionably least, it maketh about three Fifths of the whole *Plume*; in the *Radicle*, it maketh about five Seavenths of the whole *Radicle*; and in each Lobe, is so far over-proportionate, as to make at least nine Tenths of the whole Lobe.

By what hath been said, that the *Parenchyma* is not the only constituting Part, besides the Cuticle, is imply'd: there being another Body, of an essentially different substance, embosom'd herein:
which

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which may be found, not only in the *Radicle* and *Plume*, but also in the Lobes themselves, and so in the whole Bean. See *Fig. 2.*

This inner Body appears most plain and conspicuous in cutting the *Radicle* athwart, and so proceeding by degrees towards the *Plume*, through both which it runneth in a large and straight Trunk. In the Lobes, being it is there in so very small proportion, 'tis difficultly seen, especially towards their Verges: yet if with a sharp Knife you smoothly cut the Lobes of the Bean athwart, divers small Specks, of a different colour from that of the *Parenchyma*, standing therein all along in a Line, may be observ'd; which Specks are the Terminations of the Branches of this inner Body. See *Fig. 3.*

For this inner Body, as it is existent in every Organical part of the Bean; so is it, with respect to each part,

part, most regularly distributed. In a good part of the *Radicle* 'tis one entire Trunk ; towards the Basis thereof, 'tis divided into three main Branches ; the middlemost runneth directly into the Plume ; the other two on either side it, after a little space , pass into the Lobes ; where the said Branches dividing themselves into other smaller ; and those into more, and smaller again, are terminated towards the Verges of each Lobe ; in which manner the said inner Body being distributed, it becomes in each Lobe, a true and perfect Root. See *Fig. 2.*

This Seminal Root, as now we'll call it, being so tender, cannot be perfectly excarnated, as may the Vessels in the Parts of an Animal, by the most accurate Hand ; yet by dissection begun and continu'd, as is above-declared, its whole frame and distribution may be easily

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ly observ'd. Again, if you take the Lobe of a Bean, and lengthwise pare off its *Parenchyma* by degrees, and in very thin Shives, many Branches of the Seminal Root, (which by the other way of Dissection were only noted by so many Specks) both as they are fewer about the Basis of the Bean, and more numerous towards its Verges, in some good distinction and entireness will appear. For this you must have new Beans.

As the inner Body is branched out in the Lobes, so is it in the *Plume*: For if you cut the *Plume* athwart, and from the Basis proceed along the Body thereof, you'll find therein, first, one large Trunk or Branch, and after four or five very small Specks round about it, which are the terminations of so many lesser Branches therewith distributed to the several parts of the *Plume*. See Fig. 4. The distribution

tribution of the inner Body, as it is continuous throughout all the Organical Parts of the Bean, is represented by *Fig. 2.*

This *Inner Body* is, by dissection, best observable in the Bean and great Lupine. In other larger Pulse it shews likewise some obscure Marks of it-self: But in no other Seeds, which I have observed, though of the greatest size, as of *Apples, Plums, Nuts, &c.* is there any clear appearance hereof, upon dissection, saving in the *Radicule* and *Plume*; the reason of which is partly from its quantity, being in most Seeds so extraordinary little; partly from its Colour, which in most Seeds, is the same with that of the *Parenchyma* it self, and so not distinguishable from it.

Yet in a *Gourd-Seed*, the whole *Seminal Root*, not only its *Main Branches*, but also the Sub-divisi-

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ons and Inosculation of the lesser ones, are without any dissection, upon the separation of the Lobes, on their contiguous Flats immediately apparent. See *Fig 5*. And as to the existence of this Seminal Root, what Dissection cannot attain, ocular inspection in hundreds of other Seeds, even the smallest, will demonstrate; as in this *Chapter* shall be seen how.

In the mean time, let us only take notice, that we say every Plant hath its Root, we reckon short; for every Plant hath really two, though not contemporary, yet successive Roots; its Original or *Seminal-Root* within its Seed, and its *Plant-Root*, which the *Radicle* becometh in its growth: the *Parenchyma* of the Seed being in some resemblance, that to the *Seminal Root* at first, which the Mould is to the *Plant-Root* afterwards; and the *Seminal Root* being

of Vegetables. 19

ing that to the *Plant-Root*, which the *Plant-Root* is to the *Trunk*. For our better understanding whereof, having taken a view of the several Parts of a Bean, as far as Dissection conducts; we will next briefly enquire into the use of the said Parts, and in what manner they are the Fountain of Vegetation, and concurrent to the being of the future Plant.

The general Cause of the growth of a *Bean* or other Seed, is *Fermentation*; that is, the *Bean* lying in the Mould, and a moderate access of some moisture, partly dissimilar, and partly congenerous, being made, a gentle *Fermentation* thence ariseth; by which the *Bean* swelling, and the *Sap* still encreasing, and the *Bean* continuing still to swell, the work thus proceeds: as is the usual way of explicating. But that there is simply a *Fermentation*, and so a

sufficient supply of *Sap*, is not enough ; but that this *Fermentation* and the *Sap* wherein 'tis made, should be under a various Government by divers Parts thereto subservient, is also requisite ; and as the various preparation of the *Aliment* in the *Animal*, equally necessary ; the particular process of the Work according whereto, we find none undertaking to declare.

Let us look upon a *Bean* then, as a piece of Work so fram'd and set together, as to declare a Design for the production of a Plant, which, upon its lying in some convenient Soyl, is thus effected. First of all, the *Bean* being enfoulded round in its Coats, the *Sap* wherewith it is fed, must of necessity pass through these : By which means, it is not only in a proportionate quantity, and by due degrees ; but also
in

in a purer body; and possibly not without some Vegetable Tincture, transmitted to the *Bean*. Whereas, were the *Bean* naked, the *Sap* must needs be, as over-copious, so but crude and immature, as not being filtered through so fine a Cotton as the Coats be. And as they have the use of a *Filtre* to the transient *Sap*; so of a Vessel to that which is still deposited within them; being alike accommodated to the securer *Fermentation* hereof, as Bottles or Barrels are to Beer, or any other *Fermentative Liquor*.

And as the *Fermentation* is promoted by some Aperture in the Vessel; so have we the *Foramen* in the upper Coat also contrived; that if there should be need of some more airy Particles to excite the *Fermentation*, through this they may obtain their Entry: Or, on the contrary, should there

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be any such Particles or Steams as might damp the genuine proceeding thereof, through this again they may have easie issue: being that, as a common Passport here to the *Sap*, which what we call the Bung-hole of the Barrel, is to the new-tunn'd Liquor. That this *Foramen* is truly permeable even in old setting *Beans*, appears upon their being soak'd for some time in Water: For then taking them out, and crushing them a little, many small Bubbles will alternately arise and break upon it.

The *Sap* being passed through the Coats, it next enters the Body of the *Bean*; yet not indiscriminately neither; but, being filtered through the *Outer Coat*, and fermented both in the Body and Concave of the *Inner*, is by mediation of the *Cuticle*, again more finely filtr'd, and so entereth the

Pa-

Parenchyma it self under a fourth Government.

Through which Part the *Sap* passing towards the *Seminal Root*, as through that which is of a more spacious content ; besides the benefit it hath of a farther percolation, it will also find room enough for a more free and active fermenting and maturation herein. And being moreover, part of the true Body of the *Bean*, and so with its proper Seminalities or Tinctures copiously repleat ; the *Sap* will not only find room, but also matter enough, by whose Energy its *Fermentation* will still be more advanced.

And the *Sap* being duly prepared here, it next passeth into all the Branches of the *Seminal Root*, and so under a fifth Government. Wherein how delicate 'tis now become, we may conceive by the proportion betwixt the *Parenchy-*

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ma and this *Seminal Root*; so much only of the best digested *Sap* being discharged from the whole Stock in that, as this will receive. And this, moreover, as the *Parenchyma*, with its proper Seminalities being endowed; the *Sap*, for the supply of the *Radicle*, and of the young Root from thence, is duly prepared therein, and with its highest Tincture and Impregnation at last enriched.

The *Sap* being thus prepared in the Lobes of the *Bean*, 'tis thence discharg'd; and either into the *Plume* or the *Radicle*, must forthwith issue. And since the *Plume* is a dependent on the *Radicle*; the *Sap* therefore ought first to be dispenced to this; which accordingly is ever found to shoot forth before the *Plume*, and that sometimes an inch or two in length. Now because the primitive course of the *Sap* into the
Radicle,

Radicle, is thus requisite, therefore by the frame of the Parts of the *Bean* is it made necessary too. For we may observe that the two main Branches of the *Seminal Root* in which the several *Ramifications* in either Lobe are all united, commit not themselves into the *Seminal Trunk* of the *Plume*, nor yet so as to stand at right Angles with them, and with equal respect towards them both ; but being produced through part of the *Parenchyma* of the *Radicle*, are at last united therein to the main Trunk, and make acute Angles therewith; as may be seen by *Fig. 2*. Now the *Sap* being brought as far as the *Seminal Root* in either Lobe, and according to the conduct thereof continuing still to move, it must needs immediately issue into the same part whereinto the main Branches themselves do, that is, into the *Radicle*. By which *Sap*,
thus

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thus bringing the several Tinctures of the parts aforesaid with it, being now fed ; it is no longer a meer *Radicle*, but is made also *Seminal*, and so becomes a perfect Root.

The *Radicle* being thus impregnate and shot into a Root, 'tis now time for the *Plume* to rouse out of its Cloysters, and germinate too: In order whereto, 'tis now fed from the Root with laudable and sufficient Aliment. For as the Supplies and motion of the *Sap* were first made from the Lobes towards the Root, so the Root being well shot into the Moulds, and now receiving a new and more copious *Sap* from these ; the motion hereof must needs be stronger, and by degrees revert the primitive *Sap*, and so move in a contrary course, *sc.* from the *Root* towards the *Plume* ; and , by the continuation of the *Seminal Trunk*,

Trunk, is directly conducted thereinto; by which, being fed, it gradually enlarges and displays it self.

The course of the *Sap* thus turned, it issues, I say, in a direct Line from the *Root* into the *Plume*, but collaterally into the Lobes also; *sc.* by those two aforesaid Branches which are obliquely transmitted from the *Radicle* into either Lobe. By which Branches the said *Sap* being disbursed back into all the *Seminal Root*, and from thence likewise into the *Parenchyma* of the Lobes; they are both thus fed, and for some time augmenting themselves, really grow; as in *Lupines* is evident.

Yet is not this common to all Seeds; some rot under-ground, as *Corn*; being of a laxer and less Oleous substance, differing herein from most other Seeds; and being not divided into Lobes, but one entire

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entire thick Body. And some, although they continue firm, yet rise not as the great *Garden-Bean*; in which therefore it is observable, that the two Main Branches of the Lobes in comparison with that which runs into the *Plume*, are but mean, and so insufficient to the feeding and vegetation of the Lobes; the *Plume*, on the contrary, growing so lusty, as to mount up without them.

Excepting a few of these two kinds, all other Seeds whatsoever, (which I have observed) besides that they continue firm, upon the Vegetation of the *Plume*, mount also upwards, and advance above the Mould together with it; as all Seeds which spring up with dissimilar Leaves; the two (for the most part two) dissimilar Leaves, being the very Lobes of the Seed divided, expanded, and thus advanced.

The Impediments of our apprehension

hension hereof are the Colour, Size and Shape of the dissimilar Leaves. Notwithstanding, that they are nothing else but the main body of the Seed, how I came first to phansie, and afterwards to know it, was thus: First, I observed in general that the dissimilar Leaves were never jagg'd, but even edg'd: And seeing the even verges of the Lobes of the Seed hereto respondent, I was apt to think, that those which were so like, might prove the same. Next descending to particular Seeds, I observed first of the *Lupine*; that as to its Colour, upon its advance above the Mould, it ever changed into a perfect Green. And why might not the same by parity of Reason be inferr'd of other Seeds? That, as to its size, it grew but little bigger than when first set. Whence, as I discern'd (the Augmentation being but

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but little) we here had only the two Lobes: So, (as some augmentation there was) I inferr'd the like might be, and that, in farther degrees, in other Seeds.

Next, of the *Cucumber*-Seed, That, as to its Colour, often appearing above ground in its Primitive white, from white it turns to yellow, and from yellow to green, the proper colour of a Leaf: That, as to its size, though at its first arise, the Lobes were little bigger than upon setting; yet afterwards as they chang'd their Colour, so their Dimensions also, growing to a three-four-five-fold amplitude above their primitive size: But whereas the Lobes of the Seed are in proportion, narrow, short and thick, how then come the dissimilar Leaves to be so exceeding broad, or long and thin? The Question answers it self: For the dissimilar Leaves, for
that

very reason are so thin, because so very broad or long; as we see many things, how much they are extended in length or breadth, so much they lose in depth, or grow more thin; which is that which here befalls the now effoliated Lobes. For being once disimprisoned from their Coats, and the course of the Sap into them now more and more encreased, they must needs very considerably amplify themselves; and from the manner wherein the *Seminal Root* is branched in them, that amplification cannot be in thickness, but in length or breadth: In both which, in some dissimilar Leaves 'tis very remarkable; especially in length, as in those of *Lettice*, *Thorn-Apple*, and others; whose Seeds, although very small, yet the Lobes of those Seeds growing up into Dissimilar Leaves, are extended an Inch, and sometimes more,

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more, in length; though he that shall attempt to get a clear sight of the Lobes of *Thorn-Apple*, and some others, by Dissection, will find it no easie Task; yet is that which may be obtained. From all which, and the observation of other Seeds, I at last found, that the dissimilar Leaves of a young Plant, are nothing else but the Lobes or *main Body* of its Seed: So that as the Lobes did at first feed and impregnate the *Radicle* into a *perfect Root*; so the *Root* being perfected, doth again feed, and by degrees amplifie each Lobe into a perfect Leaf.

The Original of the dissimilar Leaves thus known, we understand, why some Plants have none; because the Seed either riseth not, as *Garden-Beans*, *Corn*, &c. Or upon rising, the Lobes are little alter'd, as *Lupines*, *Pease*, &c. Why, though the proper
Leaves

Leaves are often indented round; the dissimilar, like the Lobes, are even-edg'd. Why, though the proper Leaves are often hairy, yet these are ever smooth. Why some have more dissimilar Leaves than two, as *Cresses*, which have six, as the Ingenious Mr. *Sharrock* also observes; the reason whereof is, because the *Main Body* is not divided into two, but six, distinct Lobes, as I have often counted. Why *Radishes* seem at first to have four, which yet after appear plainly two; because the Lobes of the Seed have both a little Indenture, and are both plaited, one over the other. To which we might add,

The use of the dissimilar Leaves is, first, for the protection of the *Plume*; which being but young, and so but soft and tender, is provided with these, as a double Guard, one on either side of it.

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For

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For this reason it is, that the *Plume* in Corn is trussed up within a membranous Sheath; and that of a *Bean*, cooped up betwixt a pair of *Surfoyls*; but where the Lobes rise, there the *Plume* hath neither of them, being both needless.

Again, that since the *Plume*, being yet tender, may be injur'd not only by the Air, but also for want of Sap, the supplies from the Root being yet but slow and sparing; that the said *Plume* therefore, by the dissimilar Leaves, may have the advantage likewise of some refreshment from Dew or Rain. For these having their Basis a little beneath that of the *Plume*, and expanding themselves on all sides of it, they often stand after Rain, like a Vessel of Water, continually soaking and suppling it, lest its new access into the Ayr, should shrivel it.

Moreover, that since the dissimilar

milar Leaves by their Basis intercept the *Root* and *Plume*, the greater and grosser part of the Sap may be by the way deposited into those; and so the purest proceed into the yet but young and delicate *Plume*, as its fittest Aliment.

Lastly, we have here a demonstration of the being of the *Seminal Root*; which since through the colour or smallness of the Seed, it could not by dissection be observ'd, except in some few; Nature hath here provided us a way of viewing it in the now effoliated Lobes, not of one or two Seeds, but of hundreds; the *Seminal Root* visibly branching it self towards the Cone and Verges of the said Lobes, or now dissimilar Leaves.

CHAP. II.

Of the Root.

HAVING examin'd and pursu'd the Degrees of *Vegetation* in the *Seed*, we find its two Lobes have here their utmost period; and, that having conveyed their Seminalities into the *Radicle* and into the *Plume*; these therefore as the Root and Trunk of the Plant still survive: Of these in their order we next proceed to speak; and first, of the *Root*: whereof, as well as of the *Seed*, we must by Dissection inform our selves.

In Dissection of a *Root* then, we
shall

of Vegetables. 37

shall find it with the *Radicle*, as the Parts of an old man with those of a *Fœtus*, substantially one. The first Part occurring is its Skin, the Original whereof is from the Seed: For that extream thin Cuticle which is spread over the Lobes of the Seed, and from thence over the *Radicle*, upon the shooting of the *Radicle* into a Root, is co-extended, and becomes its Skin.

The next Part is the *Cortical Body*; the Original whereof likewise is from the Seed; or the *Parenchyma*, which is there common both to the Lobes and *Radicle*, being by Vegetation augmented and prolonged into the *Root*, is here the *Cortical Body*, or that which is sometimes called the *Barque*.

The Contexture of this *Cortical Body* may be well illustrated by that of a *Sponge*, being a Body Porous, Dilative, and Pliable.

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Its Pores, as they are innumerable, so extream small. These Pores are not only susceptible of so much Moisture as to fill, but also to enlarge themselves, and so to dilate the *Cortical Body* wherein they are; which by the shriv'ling in thereof, by being expos'd to the Air, is also seen. In which dilatation many of its Parts becoming more lax and distant, and none of them suffering a solution of their continuity; 'tis a Body also sufficiently pliable; or, a most exquisitely fine-wrought Sponge.

The Extention of these Pores is much alike both by their length and breadth of the Root; which from the shrinking up of the *Cortical Body*, in a piece of a cut Root, by the same dimensions, is argu'd.

The proportions of this *Cortical Body* are various: If thin, 'tis called a *Barque*; & thought to serve
to

to no other end, than what is usually ascrib'd to it as a *Barque*; which is a narrow conceit: If a Bulky Body in comparison with that within it, as in the young Roots of *Cychory*, *Asparagus*, &c. 'tis here; because the fairest, therefore taken for the prime Part; which, though, as to Medicinal use, it is; yet, as to the private use of the Plant, not so. The Colour hereof, though it be originally white, yet in the continued growth of the Root, divers Tinctures, as yellow in *Dock*, red in *Bistort*, are thereinto introduced.

Next within this Part stands the *Lignous Body*; the Original whereof, as of the two former, is from the Seed; or, the *Seminal Roots* of both the Lobes, being united in the *Radicle*, and with its *Parenchyma* co-extended, is here in the Root the *Lignous Body*.

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The Contexture hereof is, in many of its parts, much more close than that of the *Cortical*; and their Pores very different: For whereas those of the *Cortical* are infinitely numerous, these of the *Lignous* are in comparison, nothing so. But these, although fewer, yet are they many of them more open, fair, and visible: as in a very thin Slice cut athwart the young Root of a Tree, and held up against the Light, is apparent: Yet not in all equally, in *Coran-Tree*, in *Goosberry-Tree*, &c. less; in *Oak*, *Plums*, and especially *Damascens*, more; in *Elder*, *Vines*, &c. more conspicuous. And as they are different in number and size, so also (whereon the numerousness of the Pores of the *Cortical Body* principally depends) in their shape. For whereas those of the *Cortical Body* are extended much alike both by the length and breadth of the

Root;

of Vegetables. 41

Root ; these of the *Lignous* are only by the length ; which, especially in *Vines* and some other *Roots*, is evident. Of these Pores, 'tis also observable, that although in all places of the *Root* they are visible, yet most fair and open about the *Fibrous Extremities* of some *Roots* (and in many *Roots* higher) where there is no Pith. These Pores, as they shew in young *Roots* of Trees, see in *Fig. 6, & 7*.

This *Lignous Body* lieth with all its Parts, so far as they are visible, in a Circle or Ring ; yet are there divers extream small Fibres thence shooting, usually mixed with the *Cortical Body* ; and by the somewhat different colour of the said *Cortical Body* where they stand, may be noted these Fibres ; the *Cortical Body* and *Skin* all together, properly make the *Barque*.

The proportion betwixt this *Lignous Body* and the *Cortical*, is various,

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various, as was said ; yet in this, constant, *sc.* that in the fibrous, and smaller Parts of the *Root*, the *Lignous Body* is not only in compass, but in quantity the less ; running like a slender Wye or Nerve through the other surrounding it. They stand both together pyramidally, which is most common to *Infant-Roots*, but also to many other.

The next Part observable in the *Root*, is the *Insertment*. The existence hereof, so far as we can yet observe, is sometimes in the *Radicle* of the Seed itself ; I cannot say alwayes. As to its substantial nature, we are more certain ; that it is the same with that of the *Parenchyma* of the *Radicle* ; being alwayes at least augmented, and so, in part, originated from the *Cortical Body*, and so, at second hand, from the said *Parenchyma* : For in dissecting a *Root*, we find,
that

that the *Cortical Body* doth not only environ the *Lignous*, but is also wedg'd, and in many pieces inserted into it; and that the said inserted pieces make not a meer Indenture, but transmit and shoot themselves quite through as far as the Pith; which in a thin Slice cut athwart the *Root*, as so many lines drawn from the Circumference towards the Center, shew themselves. See Fig. 6, & 7.

The Pores of the *Insertment* are sometimes, at least, extended somewhat more by the breadth of the *Root*, as about the top of the *Root* of *Borage* may be seen; and are thus different from those of the *Cortical Body*, which are extended by the length and breadth much alike; and from those of the *Lignous*, being only by its length.

The number and size of these Insertions are various. In *Hawthorn*, and some others, and especially

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cially *Willows*, they are most extream small; in *Cherries* and *Plums* they are large; and in *Damascens* especially, very fairly apparent. In the *Roots* of small *Plants* they are generally more easily discoverable; which may lead to the observation of them in all.

These Insertions, although they are continuous through both the length and breadth of the *Root*; yet not so in all Parts, but by the several shootings of the *Lignous Body* are frequently intercepted. For of the *Lignous Body* it is (here best) observable, That its several shootings, betwixt which the *Cortical* is inserted, are not throughout the *Root* wholly distinct; but that all along being enarch'd, the *Lignous Body*, both in length and breadth, is thus disposed into Braces or Osculations. Betwixt these several shootings of the *Lignous Body* thus osculated, the *Cortical*

tical shooting, and being also osculated answerably Brace for Brace, that which I call the *Insertment* is fram'd thereof.

These Osculations are so made, that the Pores of the *Lignous Body*, I think, notwithstanding, seldom run one into another; but, for the most part, still keep distinct; in the same manner as some of the Nerves, though they meet, and for some space are associated together, yet 'tis most probable that none of their Fibres are truly inosculated here, but only in the Plexures.

These Osculations of the *Lignous Body*, and so the interception of the Insertions of the *Cortical*, are not to be observ'd by the traverse cut of the *Root*, but by taking off the *Barque*, or the *Cortical Body*. In the Roots of Trees, they are generally obscure; but in Plants, often more distinctly apparent;

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rent ; and especially in a *Turnep*: the appearance whereof, the *Cortical Body* being stripp'd off, is as a piece of close-wrought Network, fill'd up with the Insertions of the said *Cortical Body*. See *Fig. 8*.

The next and last distinct Part of the *Root* is the *Pith*. The substantial nature thereof, is, as was said of the *Insertment*, the same likewise with that of the *Parenchyma* of the Seed. And according to the best observation we have yet made, 'tis sometimes existent in its *Radicle* ; in which, the two main Branches of the Lobes both meeting, and being osculated together, are thus dispos'd into one round Trunk, and so environing part of the *Parenchyma*, make thereof a *Pith* ; as in either the *Radicle*, or the young *Root* of the great *Bean* or *Lupine*, may, I think, be well seen.

But many times the Original
hereof

hereof is immediately from the *Cortical Body*. For in dissection of divers *Roots* both of *Trees* and *Plants*, as of *Barberry* or *Mallows*, it is observable, that the *Cortical Body* and *Pith* are both of them participant of the same Colour; in the *Barberry* both of them tinged yellow, and in *Mallows* green. In cutting the smaller Parts of the *Roots* of many *Plants*, as of *Borage*, *Mallows*, *Parsley*, *Columbine*, &c. 'tis also evident, that the *Lignous Body* is not there in the least Concave, but standeth perfectly in the Center; and that the *Insertions* being gradually multiplied afterwards, the *Pith* at length, towards the thicker parts of the *Root*, shews and enlarges it self. Whence it appears, that in all such *Roots*, the *Pith* is not only of the same substantial nature, and by the *Insertions* doth communicate with the *Cortical Body*; and that
it

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it is also more or less augmented by it; which is true of the *Pith* of all *Roots*; but is moreover, by mediation of the said *Insertions*, wholly originated from it. The various appearances of the *Insertions* and *Pith* from the Fibrous Parts to the top of the *Root*, see in *Fig. 9, 10, 11, 12, 13, 14*. The Pores of the *Lignous Body*, entire in the said Fibrous Parts, are best seen when they have lain by a night dry, after cutting.

A farther evidence hereof are the Proportions betwixt the *Cortical Body* and *Pith*. For as about the inferiour Parts of the *Root*, where the *Pith* is small, the *Cortical Body* is proportionably great; so about the top, where the *Pith* is enlarged, the *Cortical Body* groweth proportionably less, *sc.* because by its *Insertions*, 'tis gradually bestowed into the *Pith*. Likewise the peculiar frame of some
Roots,

Roots, wherein besides the *Pith*, the *Lignous Body* being divided into a double Ring, there is also a thick Ring, of a white and soft substance, stands betwixt them; and is nothing else but the Insertions of the *Cortical Body* collected into the said Ring; but, towards the top of the Root, being inserted again, thus maketh a large and ample *Pith*; as in *Fennel-Roots* is seen.

The Pores of the *Pith*, as those of the *Cortical Body*, are extended both by the breadth and length of the *Root*, much alike; yet are they more or less of a greater size than those of the *Cortical Body*.

The Proportions of the *Pith*, are various; in Trees, but small; in Plants generally, very fair; in some making by far the greatest part of the *Root*; as in a *Turnep*: By reason of the wide circumference whereof, and so the finer

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Concoction and Assimilation of its Sap ; that part which in most old Trunks is a dry and harsh *Pith*, here proves a tender pleasant meat. The parts of a *Turnep* in the transvers cut see in *Fig. 8.*

In the Roots of very many Plants, as *Turneps*, *Carrots*, &c. the *Lignous Body*, besides its main utmost Ring, hath divers of its osculated Fibres dispersed throughout the Body of the *Pith*; sometimes all alike, and sometimes more especially in, or near, its Center; which Fibres, as they run towards the top of the *Root*, still declining the Center, at last collaterally strike into its Circumference ; either all of them, or some few, keeping the Center still ; of these principally the *Lignous Body* of the Trunk is often originated.

These Fibres, although they are so exceeding slender, yet in some
Roots,

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Roots, as in that of *Flower-de-liz*, they are visibly concave, each of them, in their several Cavities also embosoming a very small *Pith*; the sight whereof, the Root being cut traverse, and laid in a Window for a day or two to dry, may without Glasses be obtain'd. And this is the general account of the *Roots*; the declaration of the manner of its growth, with the use and service of its several parts, we shall next endeavour.

We say then, that the *Radicle* being impregnate, and shot into the Moulds, the contiguous moisture, by the *Cortical Body*, being a Body laxe and Spongy, is easily admitted: Yet not all indiscriminately, but that which is more adapt to pass through the surrounding Cuticle. Which transient Sap, though it thus becomes fine, yet is not simple; but a mixture of Particles, both in respect of those

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originally

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originally in the Root, and amongst themselves, somewhat heterogeneous. And being lodg'd in the *Cortical Body* moderately laxe, and of a Circular form; the effect will be an easie Fermentation. The *Sap* fermenting, a separation of Parts will follow; some whereof will be impacted to the Circumference of the *Cortical Body*, whence the Cuticle becomes a Skin; as we see in the growing of the Coats of Cheeses, of the Skin over divers Liquors, and the like. Whereupon the *Sap* passing into the *Cortical Body*, through this, as through a *Manica Hippocratis*, is still more finely filtred. With which *Sap*, the *Cortical Body* being dilated as far as its *Tone*, without a solution of Continuity will bear; and the supply of the *Sap* still renew'd; and the purest part, as most apt and ready, recedes, with its due Tinctures, from the said

Cortical

Cortical Body, to the *Lignous*. Which *Lignous Body* likewise super-inducing its own proper Tinctures into the said *Sap*; 'tis now to its highest preparation wrought up, and becomes (as they speak of that of an Animal) the Vegetative *Ros* or *Cambium*: the noblest part whereof is at last coagulated in, and assimilated to the like substance with the said *Lignous Body*. The remainder, though not united to it, yet tinctur'd therein, thus retreats, that is, by the continual appulse of the *Sap*, is in part carried off into the *Cortical Body* back again, the *Sap* whereof it now tinctures into good Aliment: So that whereas before the *Cortical Body* was only relaxed in its Parts, and so dilated; 'tis now increas'd in real quantity or number of parts, and so is truly nourish'd. And the *Cortical Body* being saturate with so much of this Vital *Sap* as serves

it self; and the second Remainders discharged thence to the Skin; this also is nourish'd and augmented therewith. So that as in an *Animal Body* there is no instauration or growth of Parts made by the Bloud only, but the *Nervous Liquor* is also thereunto assistant; so is it here: the *Sap* prepared in the *Cortical Body*, is as the Arterious; and that part thereof prepared by the *Lignous*, is as the *Nervous Liquor*; which partly becoming Nutriment to it self, and partly being discharged back into the *Cortical Body*, and diffusing its Tincture through the *Sap* there, that to the said *Cortical Body* and *Skin*, becomes also true Nutriment, and so they all now grow.

In which growth, a proportion in length and breadth is requisite: which being rated by the benefit of the Plant, both for firm standing and sufficient Sap, must therefore

fore principally be in length. And because it is thus requisite, therefore by the constitution of one of its Parts, *sc.* the *Lignous Body*, it is also made necessary. For the Pores hereof, in that they are all extended by its length, the *Sap* also according to the frame and site of the said Pores will principally move; and that way as its *Sap* moves, the same way will the generation of its Parts also proceed; *sc.* by its length. And the *Lignous Body* first (that is, by a priority causal) moving in length it self; the *Cortical* also moves therewith. For that which is nourish'd, is extended; but whatever is extended, is mov'd; that therefore which is nourish'd, is mov'd: The *Lignous Body* then being first nourish'd, 'tis likewise first mov'd, and so becomes and carries in it the Principle of all Vegetative moti-

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on in the *Cortical*; and so they both move in length.

Yet as the *Lignous Body* is the Principle of Motion in the *Cortical*; so the *Cortical* is the Moderator of that in the *Lignous*: As in Animal Motions, the Principle is from the Nerves; yet being one given to the Muscle or Limb, and that moving proportionably to its structure, the Nerves also are carried in the same motion with it. We suppose therefore, that as the principal motion of the *Lignous Body* is in length, so is its proper tendency also to ascend: But being much exceeded both in Compass and Quantity by the *Cortical*, as in the smaller parts of the *Root* it is; it must needs therefore be over-born and governed by it; and so, though not lose its motion, yet make it that way wherein the *Cortical Body* may be more obedient to it; which will be by descent:

scant: Yet both of them being sufficiently pliable, they are thus capable, where the Soyl may oppose a direct descent, there to divert any way where it is more penetrable, and so to descend obliquely. For the same reason it may also be, that though you set a *Bean* with the *Radicle* upward; yet the *Radicle*, as it shoots, declining also gradually, is thus arch'd in form of an Hook, and so at last descends. For every declination from a perpendicular Line, is a mixed motion betwixt Ascent and Descent; as that of the *Radicle* also is, and so seeming to be dependent upon the two contrary Tendencies of the *Lignous* and *Cortical Bodies*. What may be the cause of those Tendencies (being most probably external, and perhaps something of a *Magnetisme*) is besides my Task here to enquire.

Now although the *Lignous Body*,
by

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by the position and shape of its Pores, principally groweth in length; yet will it in some degree likewise in breadth: For it cannot be supposed that the purest *Sap* is all received into the said Pores; but that part thereof likewise, staying about its *Superficial parts*, is there tinctur'd and agglutinated to them. And because these Pores are prolonged by its length; therefore is it much more laxe and easily divisible that way; as in flitting a Stick, or cleaving of Timber, and in cutting and hewing them athwart is also seen. Whence it comes to pass, that in shooting from the Center towards the Circumference, and there finding more room, its said original Laxity doth easily in divers places now become greater, and at length in open Partments plainly visible. Betwixt which Partments, the *cortical Body*, being bound in on the one hand,

hand, by the furrounding Skin and Moulds, and pressed upon by the *Lignous* on the other, must needs insert it self, and so move contrary to it, from the Circumference towards the Center: where the said contrary motions continued as begun, they at last meet, unite, and either make or augment the *Pith*. And thus the *Root* is fram'd, and the Skin, the *cortical* and *Lignous Bodies*, so as is said, hereunto concurrent. We shall next shew the use of the two other Parts, *sc.* the *Insertment* and *Pith*; and first of the *Pith*,

One true use of the *Pith* is for the better Advancement of the *Sap*, whereof we shall speak in the next Chapter. The use we here observe is for the quicker and higher Fermentation of the *Sap*: For although the Fermentation made in the *Cortical Body* was well
sub-

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subservient to the first Vegetations;
 yet those more perfect ones in the
Trunk which after follow, require
 a Body more adapted to it, and
 that is the *Pith*; which is so neces-
 sary, as not to be only common to,
 but considerably large in the *Roots*
 of most Plants; if not in their in-
 ferious parts, yet at their tops.
 Where though either deriv'd or
 amplify'd from the *Cortical Body*,
 yet being by its Insertions only,
 we may therefore suppose, as those,
 so this, to be more finely constitu-
 ted. And being also from its co-
 arctation, while inserted, now free;
 all its Pores, upon the supply of
 the *Sap*, will more or less be ampli-
 fied: Upon which accounts, the
Sap thereinto received, will be
 more pure, and its fermentation
 therein more active. And as the
Pith is superious to the *Cortical*
Body by its Constitution, so by its
 Place. For as it thus stands cen-
 tral,

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tral, it hath the *Lignous Body* surrounding it. Now as the Skin is the Fence of the *Cortical Body*, and that of the *Lignous*; so is the *Lignous* again a far more preheminent one unto the *Pith*; the *Sap* being here a brisk Liquor, tunn'd up as in a wooden Cask.

And as the *Pith* subserves the higher Fermentation of the *Sap*; so do the Insertions its purer Distribution; that separation which the parts of the *Sap*, by being ferment-ed in the *Pith*, were dispos'd for; being, upon its entrance into the Insertions, now made: So that as the Skin is a Filtre to the *Cortical Body*, so are the Insertions a more preheminent one to the *Lignous*; and as they subserve the purer, so the freer and sufficient distribution of the *Sap*: For the *Root* enlarging, and so the *Lignous Body* growing thicker, although the *Cortical* and the *Pith* might supply

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ply *Sap* sufficient to the nutrition of its Parts next adjacent to them; yet those more inward, must needs be scanted of their *Aliment*; and so, if not quite starv'd, yet be incapable of equal growth: Whereas the *Lignous Body* being through its whole breadth frequently disparted, and the *Cortical Body* inserted through it; the *Sap* by those Insertions, as the Blood by the disseminations of the *Arteries*, is freely and sufficiently convey'd to its intimate Parts, even those which from either the *cortical Body* or the *Pith* are most remote. Lastly, as the consequent hereof, they are thus assistant to the Latitudinal growth of the *Root*; as the *Lignous Body* to its growth in length; so these Insertions of the *Cortical*, to its better growth in breadth.

Having thus seen the solitary uses of the Several Parts of the *Root*, we shall lastly propound our
 Con-

of Vegetables. 61

Conjectures of that Design where-
to they are all together concur-
rent, and that is the Circulation of
the *Sap*: For the *Sap* moving through
the *cortical Body*, towards the *Pith*,
through the Insertions thereinto,
obtains a pass: Which passage,
the superiour Insertions will not
favour; because the *Pith* standing
in the same height with them, is
there large, the fermenting and
course of the *Sap* quick, and so its
opposition strong. But through
the inferiour it will much more ea-
sily enter; because there, through
the smalness of the *Pith*, the op-
position is little, and through the
shortness of the Insertions, the way
more open. So that though the
Sap may meet with some opposition
even here, yet here meeting with
the least, here it will bestow it
self (feeding the *Lignous Body* in
its passage) into the *Pith*. Into
which fresh *Sap* still entring, this,
being

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yet but crude, will subside: that first receiv'd and so become a Liquor higher wrought, will more easily mount upwards; and moving in the *Pith*, as in the *Arteria magna*, in equal altitude with the more superiour Insertions; the most volatile parts of all will still continue their direct ascent towards the *Trunk*. But those of a middle nature, and, as not apt to ascend, so being lighter than those beneath them, not to descend neither; they will tend from the *Pith* towards the Insertions in a motion betwixt both; through which Insertions (feeding the *Lignous Body* in its passage) it is, by the next subsequent *Sap*, discharged off into the *cortical Body*, as into the *Vena cava*, back again. Wherein, being still pursu'd by fresh *Sap* from the Center, and more occurring from the Circumference, towards the inferiour Insertions

ertions it thus descends; through
 which, together with part of the
Sap afresh imbib'd from the Mould,
 it re-enters the *Pith*. From whence,
 into the *Cortical Body*, and from
 thence into the *Pith*, the cruder
 part thereof reciprocally is dis-
 burs'd; while the most Volatile,
 not needing the help of a Circula-
 tion, more directly ascendeth to-
 wards the *Trunk*.

CHAP. III.

Of the Trunk.

HAVING thus declar'd the degrees of *Vegetation* in the *Root*; the continuance hereof in the *Trunk* shall next be shew'd: in order to which, the Parts whereof this likewise is compounded, we shall first observe.

That which without dissection shews it self, is the *Coarcture*: I cannot say of the *Root*, nor of the *Trunk*; but what I chuse here to mention, as standing betwixt them, and so being common to them both; all their Parts being here bound in closer together, as
in

in the tops of the grown Roots of very many Plants, is apparent.

Of the Parts of the *Trunk*, the first occurring is its *Skin*: The Formation whereof, is not from the Air, but in the *Seed*, from whence it is originated; being the production of the *Cuticle*, there investing the two *Lobes* and *Flume*.

The next Part is the *Cortical Body*; which herein the *Trunk* is no new substantial formation; but, as is that of the *Root*, originated from the *Parenchyma* of the *Seed*; and is only the increase and augmentation thereof. The *Skin*, this *Cortical Body* properly so call'd, and (for the most part) some Fibers of the *Lignous* mixed herewith, all together make the *Barque*.

Next, the *Lignous Body*, which, whether it be visibly divided into many softer Fibres, as in *Fennel*, and most Plants; or that its parts

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stand more compact and close, shewing one hard, firm and solid piece, as in Trees; it is in all one and the same Body; and that not formed originally in the *Trunk*, but in the *Seed*; being nothing else but the prolongation of the *Inner Body* distributed in the *Lobes* and *Plume* thereof.

Lastly, The *Insertions* and *Pith* are here originated likewise from the *Plume*, as the same in the *Root* from the *Radicle*: So that as to their substantial Parts, the *Lobes* of the *Seed*, the *Radicle* and *Plume*, the *Root* and *Trunk* are all one.

Yet some things are more fairly observable in the *Trunk*. First, the *Latitudinal* shootings of the *Lignous Body*, which in *Trunks* of several years growth, are visible in so many Rings, as is commonly known: For several young Fibres of the *Lignous Body*, as in the *Root*, so here, shooting into the
Cortical

of Vegetables. 69

Cortical one year, and the spaces betwixt them being after fill'd up with more (I think not till) the next, at length they become altogether a firm compact Ring; the perfection of one Ring, and the ground-work of another being thus made concomitantly.

From these Annual younger Fibres it is, that although the *Cortical Body* and *Pith* are both of the same substantial nature, and their Pores little different; yet whereas the *Pith*, which the first year is green, and of all the Parts the fullest of *Sap*, becomes afterwards white and dry; the *Cortical Body*, on the contrary, so long as the Tree grows, ever keepeth green and moist, *ſc.* because the said Fibers annually shoot into, and so communicate with it.

The Pores likewise of the *Lignous Body*, many of them in well-grown Timber, as in Oaken boards,

are very conspicuous, in cutting both lengthwise and traverse; they very seldom run one into another, but keep, like so many several Vessels, all along distinct; as by cutting, and so following any one of them as far as you please, for a Foot or half a Yard, or more together, may be observ'd.

These greater Pores, though in Wainscot, Tables, and the like, where they have lain long open, they are but meer Vacuities, and so would be thought to contain only *Sap* in the Tree, and afterwards only Air; yet upon a fresh cut, each of them may be seen fill'd up with a light and spongie Body, which by Glasses, and even by the bare eye, appears to be a perfect *Pith*; sometimes entire, and sometimes more or less broken.

Besides these, there are a lesser sort; which, by the help of a *Microscope*, also appear, if not to be
fill'd

fill'd up with a *Pith*, yet to contain certain light and filmy parts, more or fewer, of a *Pithy* nature within them.

And these are all the Pores the best Glasses, which, (when upon these Enquiries) we had at hand, would shew us. But the Learned and most Ingenious Naturalist Mr. *Hook* sheweth us moreover, besides these, a third, and yet smaller sort; the description whereof I find he hath given us amongst his *Microscopical Observations*. Of these Pores (as a confirmation of what, in the Second Chapter, I have said of the Pores of the *Lignous Body* in general) he also demonstrates; that they are all continuous and prolonged by the length of the *Trunk*, as are the greater ones; the Experiment whereof he imparteth to be, by filling up, suppose in a piece of *Char-coal*, all the said Pores with

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Mercury; which appears to pass quite through them, in that by a very good Glass it is visible in their Orifices at both ends; and without a Glass, by the weight of the Coal alone, is also manifest.

Upon farther Enquiry, I likewise find, that the Pores of the *Lignous Body* in the *Trunk* of Plants, which at first we only supposed, by the help of good Glasses are very fairly visible; each Fibre being perforated by 30, 50, 100, or hundreds of Pores. Or what I think is the truest notion of them, that each Fibre, though it seem to the bare eye to be but one, yet is indeed a great number of Fibres together; every Pore being not meerly a space betwixt the several pores of the Wood, but the Concave of a Fiber: So that if it be asked, what all that part of a Vegetable, either Plant or Tree, which is properly call'd the woody part,

part; what all that is, I suppose, that is nothing else but a Cluster of innumerable and most extraordinary small Vessels or concave Fibres. See *Fig. 15.*

Next the Insertions of the *Cortical Body*, which in the *Trunk* of a Tree saw'd athwart, are plainly discerned as they run from the Circumference toward the Center; the whole Body of the Tree being visibly compounded of two distinct Substances, that of the several Rings, and that of the Insertions, running cross; shewing that in some resemblance in a Plain, which the Lines of Latitude and of the Meridian do in a Globe. See *Fig. 16.*

These Insertions are likewise very conspicuous in Sawing of Trees length-ways into Boards, and those plain'd, and wrought into Leaves for Tables, Wainscot, Trenchers, and the like. In all
which,

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which, as in course Trenchers made of *Beech*, and Tables of *Oak*, there are many parts which have a greater smoothness than the rest; and are so many inserted pieces of the *Cortical Body*; which by reason of those of the *Lignous*, seem to be discontinuous, although in the *Trunk* they are extended throughout its Breadth.

These Insertions, although as is said, of a quite distinct substance from the *Lignous Body*, and so nowhere truly incorporated with it, yet being they are in all parts, the one as the Warp, the other as the Woof, mutually braced and interwoven together, they thus constitute one strong and firmly coherent Body.

As the Pores are greater or less, so are the Insertions also: To the bare eye usually the greater only are discernable: But through an indifferent *Microscope* there are others

others also, much more both numerous and small, distinctly apparent. So that, I think, we may observe, that as the grand *Pith* of the *Trunk* communicates with, and is augmented by the greater Insertions; so is the *Pith* of each greater Pore originated from the less; and those (at least) pithy parts in the Midling Pores, from others still less; and suppose, that the least of all are so far intruded into the smallest Pores, as only just to cause a kind of roughness on their concave sides, and no more; to what end shall be said See *Fig. 17*.

In none of all these Pores can we observe any thing which may have the true nature and use of Valves, which is easily to admit that, to which they will by no means allow a regress. And their non-existence is enough evident, from what in the first Chapter we have said of the *Lobes* of the *Seed*:
in

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in whose *Seminal Root*, were there any *Valves*, it could not be, that by a contrary course of the *Sap*, they should ever grow ; which yet, where-ever they turn into *Dissimilar Leaves*, they do. Or if we consider the growth of the *Root*, which oftentimes is upward and downward both at once.

The *Insertions* here in the *Trunk* give us likewise a sight of the position of their *Pores*. For in a plained piece of *Oak*, as in *Wainscot*, *Tables*, &c. besides the larger *Pores* of the *Lignous Body*, which run by the length of the *Trunk*; the *Tract* likewise of those of the *Insertions* may be observed to be made by the breadth, and so directly cross. Nor are they continuous as those of the *Lignous Body*, but very short, as those both of the *Cortical Body* and *Pith*, with which the *Insertions*, as to their substance are congenerous. Yet they

they all stand so together, as to be plainly ranked in even Lines or Rows throughout the breadth of the *Trunk*: As the Tract of these Pores appear to the naked Eye, see in *Fig. 18*. By the best Microscope I have at hand, I can only observe the Ranks of the Pores; not the Pores themselves, saving here and there one; wherefore I have not describ'd them.

The Pores of the *Pith* likewise being larger here in the *Trunk*, are better observable than in the *Root*: the width whereof, in comparison with their sides so exquisitely thin, may by an Honey-Comb be grossly exemplified; and is that also which the vast disproportion betwixt the Bulk and weight of a dry *Pith* doth enough declare. In the *Trunks* of some Plants, they are so ample and transparent, that in cutting both by the length and breadth of the *Pith*, some of them, even to the

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the bare eye would seem to be considerably extended by the length of the said *Pith*; which once I also thought they were, and that only the rest of them were but short and discontinuous, and as 'tis said, somewhat answerable to the Cells of an Honey-Comb. This was the nearest we could come to them, by conjecture, and the assistance of the best Glasses we then had by us, when upon enquiry into the nature of the *Pith*: But that Worthy Person newly mentioned Mr. Hooke sheweth us, that the Pores of the *Pith*, particularly of *Elder-Pith*, so far as they are visible, are all alike discontinuous; and that the *Pith* is nothing else (to use his own words) but an heap of Bubbles.

Besides what this Observation informs us of here, it farther confirms what in the second Chapter we have said of the Original of the
Pith

Pith and *Cortical Body*, and of the sameness of both their natures with the *Parenchyma* of the Seed. For, upon farther enquiry with better Glasses, I find, that the *Parenchyma* of the *Flume* and *Radicle*, and even of the *Lobes* themselves, though not so apparently, is nothing else but a Mass of Bubbles.

In the *Piths* of many Plants, the greater Pores have some of them lesser ones within them, and some of them are divided with cross Membranes: And betwixt their several sides, have, I think, other smaller Pores visibly interjected. However, that they are all permeable, is most certain. They stand together not indeterminately, but in even Ranks or Trains; as those of the Insertions by the breadth, so these by the length of the *Trunk*. And thus far there is a general corresponding betwixt the part of the *Root* and *Trunk*: Yet are there
some

some considerable Disparities betwixt them; wherein, and how they come to pass, and to what especial use and end, shall next be said.

We say then, that the *Sap* being in the *Root* by Filtrations, Fermentations (and in what *Roots* needful, perhaps by Circulation also) duly prepar'd; the prime part thereof passing through the intermediate Coarcture, in due moderation and purity is entertain'd at last into the *Trunk*. And the *Sap* of the *Trunk* being purer and more volatile, and so it self apt to ascend; the motion of the *Trunk* likewise will be more noble, receiving a disposition and tendency to ascend therewith. And what by the *Sap* the *Trunk* is in part dispos'd to, by the respective position and quantity of its Parts it is effectually enabled. For whereas in the *Root* the *Lignous Body*

Body being in proportion with the *Cortical*, but little, and all lying close within its Center; it must therefore needs be under its controul: on the contrary, being here comparatively of greater quantity, and also more dilated, and having divers of its Branches standing more abroad towards the Circumference, as both in the Leaves and Body of the young *Trunk* and *Plume*, is seen; it will in its own tendency to ascend, reduce the *Cortical Body* to a compliance with it.

And the *Trunk* thus standing from under the restraint of the Mould in the open Air, the disposition of its Parts originally different from that of the Parts in the Root will not only be continued, but improved: For by the force and pressure of the *Sap* in its collateral Motion, the *Lignous Body* will now more freely and farther

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be

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be dilated. And this being dilated, the *Cortical Body* also, must needs be inserted; and is therefore in proportion alwayes more or less smaller here in the *Trunk*, than in the *Root*. And as the *Cortical Body* lessens, so the *Pith* will be enlarged, and by the same proportion is here greater. And the *Pith* being enlarged it self, its Pores (the *Lignous Body*, upon its dilatation, as it were tentering and stretching out all their sides) must needs likewise be enlarged with it, and accordingly are ever greater in the *Pith* of the *Trunk*, than of the *Root*. And the dilatation of the *Lignous Body* still continued, it follows, that whereas the *Pith* descendent in the *Root*, is not only in proportion less and less, but also in the smaller extremities thereof and sometimes higher altogether absent: Contrariwise, in the *Trunk* it is not only
con-

continued to its top, but also there in proportion equally ample with what it is in any other inferior part.

But although the openness of the Ayr permitting be alwayes alike; yet the Energy of the *Sap* effecting, being different; as therefore that doth, the dilatation of the *Trunk* will also vary. If that be less, so is this; as in the *Trunks* of most Trees: If that be greater, so is this; as in Plants is common; the *Lignous Body* being usually so far dilated, that the *utmost Shootings* thereof may easily be seen to jut out, and adjoyn to the Skin. And if the *Sap* be still of greater energy, it so far dilates the *Lignous Body*, as not only to amplify the *Pith* and all its Pores; but also so far to stretch them out, as to make them tear. Whereupon either running again into the *Cortical Body*, or shrinking up to-

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wards

wards it, the *Trunk* thus sometimes becomes an *hollow Stalk*, the *Pith* being wholly, or in part voyded. But generally it keeps entire; and where it doth, the same proportion and respect to the *Lignous* and *Cortical Bodies*, as is said. The Consequences of all which will be, the strength of the *Trunk*, the security and plenty of the *Sap*, its Fermentation will be quicker, its Distribution more effectual, and its Advancement more sufficient.

First, the erect growth and strength of the *Trunk*; this being by the position of its several parts effected: For besides the slendering of the *Trunk* still towards the top, the Circumferential position of the *Lignous Body* likewise is, and that eminently hereunto subservient: So that as the *Lignous Body* in the smaller part of the *Root* standing Central, we may thence conceive

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conceive and see their pliability to any oblique motion ; so here, on the contrary, the *Lignous Body* standing wide, it thus becomes the strength of the *Trunk*, and most advantageous to its perpendicular growth. We see the same Design in *Bones* and *Feathers* : The strongest *Bones*, as those in the Legs, are hollow. Now should we suppose the same *Bone* to be contracted into a Solid Body, although now it would be no heavier, and in that respect, as apt for motion ; yet would it have far less strength, than as it is dilated to a Circumferential posture. And so for *Quills*, which, for the same Reasons, in subserviency to flight, we see how exceeding light they are, and yet, in comparison with the thinness of their Body, how very strong : We see it not only in Nature, but Art. For hence it is that *Joyners* and *Carpenters*

unite and set together their Timber-pieces and several Works oftentimes with double Joynts; which, although they are no thicker than a single one might be made, yet standing at a distance, have a greater strength than that could have. And the same Architecture will have the same use in the *Trunks* of Plants, in most whereof 'tis very apparent; as for instance, in Corn: For Nature designing its *Sap* a great Ascent for its higher maturity, hath given it a tall *Trunk*; but to prevent its ravenous despoiling either of the Ear or Soyl; although it be tall, yet are its sides but thin: and because again, it should grow not only tall and thriftily, but for avoiding propping up, strongly too; therefore, as its height is over-proportioned to the thinness of its sides, so is its Circumference also; being so far dilated as to parallel a *Quill*
it

it self. Besides the position of the *Lignous Body* within the compass of a Ring, we see some shootings thereof often standing beyond the Circumference of the said Ring, making sometimes a triangular, oftner a quadrangular Body of the *Trunk*; to the end, that the Ring being but thin, and not self-sufficient, these, like Splinters to *Bones*, might add strength and stability to it.

Next, the security and plenty of the *Sap*. For should the *Lignous Body*, as it doth in the *Root*, its smaller parts, stand Central here also, and so the *Cortical* wholly surround it: the greater part of the *Sap* would thus be more immediately expos'd to the Sun and ayr; and being lodg'd in a laxe Body, by them continually be prey'd upon, and as fast as suppli'd to the *Trunk*, be exhausted. Whereas the *Pith* standing in the

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Center,

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Center, the *Sap* therein being not only most remote from the Ayr and Sun, but by the *Barque*, and especially the *Wood*, being also furrouded and doubly immur'd, will very securely and copiously be convey'd to all the Collateral parts, and (as shall be said how) the top of the *Trunk*.

And the *Sap* by the amplitude, and great porosity of the *Pith* being herein more copious, its Fermentation also will be quicker; which we see in all Liquors by standing in a greater quantity together, proceeds more kindly: And being tunn'd up within the *Wood*, is at the same time not only secur'd from loss, but all extream mutations, the Day being thus not too hot, nor the Night too cold for it.

And the Fermentation hereof being quicker, its motion also will be stronger, and its distribution
more

of Vegetables. 89

more effectual, not only to the dilatation of the *Trunk*, but likewise the shooting out of the *Branches*. Whence it is, that in the Bodies of Trees, the *Barque* of it self, though it be sappy, and many Fibres of the *Lignous Body* mixed with it, yet seldom sendeth forth any; and that in Plants, those with the least *Pith* (other advantages not supplying this defect) have the fewest or smallest *Branches*, or other collateral Growths: and that *Corn*, which hath no *Pith*, hath neither any *Branches*.

Lastly, the Advancement of the *Sap* will hence also be more ready and sufficient. For the understanding where, and how, we suppose that in all *Trunks* whatsoever there are two parts joyntly hereunto subservient. In some the *Lignous Body* and the *Cortical*, as in older *Trunks*, the *Pith* being either

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excluded or dried: But in most, principally the *Lignous Body* and *Pith*; as in most Annual Growths of Trees; but especially Plants, where the *Cortical Body* is usually much and often wholly inserted.

Of the *Lignous* body it is so apparent by its Pores, or rather by its Vessels, that we need no farther evidence. For as to what end are Vessels but for the conveyance of Liquor? And is that also, which upon cutting the young Branch of a Sappy Tree or Plant, by an accurate and steady view may be observed. But when I say the Pores of the *Lignous Body*, I mean principally them of the younger shootings, both those which make the new Ring, and those which are mixed with the *Cortical Body* in the *Barque*: that which ascendeth by the Pores of the older Wood, being probably, because in less quan-

quantity, more in form of a Vapour, than a Liquor. Yet that which drenching into the sides of its Pores, is with all thereunto sufficient Aliment; as we see *Orpine, Onions, &c.* only standing in a moyster Ayr will often grow; And being likewise in part supplied by the Insertions from the younger Shoots: But especially, because as it is but little, so it serveth only for the growth of the said *Elder Wood*, and no more; whereas the more copious Aliment ascendent by the younger Shoots, subserves not only their own growth, but the generation of others; and is besides with that in the *Cortical Body* the Fountain of *Perspirations*, which we know even in Animals are much more abundant than the *Nutritive parts*; and doubtless in a *Vegetable* are still much more.

But these Pores, although they are a free and open way to the ascend-

ascending *Sap*; yet that meer Pores or Vessels should be able of themselves to advance the *Sap* with that speed, strength & plenty, and to that height, as is necessary, cannot probably be supposed. It follows then, that herein we must grant the *Pith* a joynt service. And why else in the smaller parts of the *Root*, where the *Pith* is often wanting, are the Pores there greater? Why is the *Pith* in all primitive growths the most *Sappy* part, why hath it so great a stock of *Sap*, if not after due maturation within it self still to be disbursed into the Fibres of the *Lignous Body*? Why are the annual growths of all both Plants and Trees with great Piths, the quickest and the longest? But how are the Pores of the *Pith* permeable? That they are so, both from their being capable of a repletion with *Sap*, and of being again wholly emptied of it, and
 again,

again, instead thereof fill'd with Ayr, is as certain as that they are Pores. That they are permeable, by the breadth, appears from the dilatation of the *Lignous Body*, and and from the production of Branches, as hath been, and shall hereafter be said. And how else is there a Communion betwixt this and the *Cortical Body*? That they are so also, by the length, is probable, because by the best *Microscope* we cannot yet observe, that they are visibly more open by the breadth, than by the length. And withal are ranked by the length, as those of the Insertions by the breadth of the *Trunk*. But if you set a piece of dry *Elder-Pith* in some tinged Liquor, why then doth it not penetrate the Pores, so as to ascend through the Body of the *Pith*? The plain reason is, because they are all fill'd with Ayr. Whereas the *Pith* in a Vegetating Plant, as its Parts
or

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or Pores are still generated, they are at the same time also fill'd with *Sap* ; which, as 'tis gradually spent, is still repair'd by more succeeding, and so the Ayr still kept out ; as in all primitive growths, and the *Pith* of *Elder* it self : Yet the same *Pith*, by reason of the following Winter, wanting a more copious and quick supply of *Sap*, thus once become, ever after keeps dry. And since in the aforesaid Trial the Liquor only ascends by the sides of the *Pith*, that is of its broken Pores, we should thence by the same reason conclude that they are not penetrable by the breadth neither, and so no way ; and then it need not be ask'd what would follow. But certainly the *Sap* in the Pores of the *Pith* is discharged and repaired every moment, as by its shriv'ling up, upon cutting the Plant is evident.

We suppose then, that as the
Sap

Sap ascendeth into the *Trunk* by the *Lignous Body*, so partly also by the *Pith*. For a piece of *Cotton* with one end immers'd in some tinged Liquor, and with the other erect above, though it will not imbibe the Liquor so far as to overrun at the top, yet so as to advance towards it, it will; so here, the *Pith* being a porous and spongy Body, and in its Vegetating state its Pores also permeable, as a curious Filtre of Natures own contrivance, it thus advanceth, or as people use to say, sucks up the *Sap*. Yet as it is seen of the Liquor in the *Cotton*; so likewise are we to suppose it of the *Sap* in the *Pith*; that though it riseth up for some way, yet is their some term, beyond which it riseth not, and towards which the motion of the ascending *Sap* is more and more broken, weak and slow, and so the quantity thereof less and less. But because
the

the *Sap* moveth not only by the length, but breadth of the *Pith*; at the same time therefore as it partly ascendeth by the *Pith*, it is likewise in part pressed into the *Lignous Body* or into its Pores. And since the motion of the *Sap* by the breadth of the *Pith* not being far continued, and but collateral, is more prone and easie than the perpendicular, or by its length; it therefore follows, that the collateral motion of the *Sap*, at such a height or part of the *Pith*, will be equally strong with the perpendicular at another part, though somewhat beneath it; and that where the perpendicular is more broken and weak, the collateral will be less; and consequently where the perpendicular tendency of the *Sap* hath its term, the collateral tendency thereof, and so its pressure into the Pores of the *Lignous Body* will still continue.

Through

Through which, in that they are small, and so their sides almost contiguous, the *Sap* as fast as pressed into them will easily run up; as betwixt the two halves of a Stick first slit, and then tied somewhat loosely together, may also any Liquor be observed to do. And the sides of the said Pores being not smooth, but by the intrusion of the smallest insertions made somewhat rough; by that means the higher and more facile ascent of the *Sap* therein will farther be promoted. By all which Advantages the facility and strength of that ascent will be continued higher in the said Pores than in the *Pith*. Yet since this also, as well as that in the *Pith* will have its term; the *Sap*, although got thus far, would yet at last be stagnant, or at least its ascent be very sparing, slow and feeble, if not some way or other re-inforced. Wherefore, as the

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Sap

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Sap moving by the breadth of the *Pith*, presseth thence into the Pores of the *Lignous Body*; so having well fill'd these, is in part by the same Collateral motion disbursted back into a yet higher Region of the *Pith*. By which partly, and partly by that portion of the *Sap*, which in its perpendicular ascent was before lodged therein; 'tis thus here, as in any inferiour place equally repleat. Whereupon the force and vigour of the perpendicular motion of the *Sap* herein will likewise be renew'd; and so its Collateral motion also, and so its pressure into the Pores of the *Lignous Body*, and consequently its ascent therein; and so by a pressure from these into the *Pith*, and from the *Pith* into these reciprocally carried on, a most ready and copious ascent of the *Sap* will be continued from the bottom to the top, though of the highest *Trunk*.

An

An Appendix.
Of Trunk-Roots and
Claspers.

THe distinct Parts whereof these are constituted, are the same with those of the *Trunk*, and but the continuation of them.

Trunk-Roots are of two kinds: Of the one, are those that vegetate by a direct descent: The place of their Eruption is sometimes all along the *Trunk*; as in *Mint*, &c. Sometimes only at its utmost point, as in the *Bramble*.

The other sort are such as neither ascend nor descend, but shoot

forth at right Angles with the *Trunk*; which therefore, though as to their Office, they are true *Roots*, yet as to their Nature, they are a *Middle thing* betwixt a *Root* and a *Trunk*.

Claspers, though they are but of one kind, yet their nature is double; not a mean betwixt that of the *Root* and that of the *Trunk*, but a compound of both; as in their Circumvolutions, wherein they often mutually ascend and descend, is seen.

The use of these Parts may be observed as the *Trunk* mounts, or as it trails. In the mounting of the *Trunk*, they are for support and supply: For support, we see the *Claspers* of *Vines*; the Branches whereof being very long, fragile and slender, unless by their *Claspers* they were mutually contain'd together, they must needs by their own weight, and that of
their

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their Fruit, undecently fall, and be also liable to frequent breaking. So that the whole care is divided betwixt the Gardener and Nature; the Gardener with his Ligaments of Leather secures the main Branches; and Nature with these of her own finding, secures the less. Their Conveniency to which end, is seen in their Circumvolutions, a motion not proper to any other Part: As also in their toughness or strength, though much more slender than the Branches whereon they are appendent.

For Supply, we see the *Trunk-Roots* of *Ivy*: For mounting very high, and being of a closer Constitution than that of a *Vine*, the *Sap* could not be sufficiently supplied to the upper Sprouts, unless these to the *Mother-Root* were joyntly assistant. Yet serve they for support likewise; whence they shoot out, not as in *Cresses*, *Brook-*

lime, &c. reciprocally on each side, but commonly all in one; that so they may be fastened at the nearest hand.

In the Trailing of the *Trunk*, they serve for stabiliment, propagation and shade. For stabiliment, we see the *Claspers* of *Cucumbers*: For the *Trunk* and *Branches* being long and fragile, the *Brushes* of the *Winds* would injuriously hoise them to and fro, to the dammage both of themselves and their tender *Fruit*, were they not by these *Ligaments* brought to good Association and Settlement.

As for this end, so for Propagation, we see the *Trunk-Roots* of *Camomile*. Whence we have the reason of the common observation, that it grows better by being trod upon: the *Mould*, where too laxe, being thus made to lie more conveniently about the said *Trunk-Roots* newly bedded therein; and

is

is that which we see also effected in Rowling of *Corn*.

For both these ends, we see the *Trunk-Roots* of *Strawberries*; as also for shade; for in that we see all *Strawberries* delight; and by the trailing of the Plant is well obtain'd: So that as we are wont to tangle the Twigs of Trees together to make an *Arbour Artificial*; the same is here done to make a *Natural one*; as likewise by the *Claspers* of *Cucumbers*: For the Branches of the one by the Linking of their *Claspers*, and of the other by the Tethering of their *Trunk-Roots*, being couched together; their tender fruits thus lie under the Umbrage of a *Bower* made of their own Leaves,

CHAP. IV.

*Of the Germen, Branch,
and Leaf.*

THE Parts of the *Germen* and *Branch*, are the same with those of the *Trunk*; the same *Skin*, *Cortical* and *Lignous Bodies*, *Insertment* and *Pith*, hereinto propagated, and distinctly observable herein.

For upon Enquiry into the Original of a *Branch* or *Germen*, it appears, That it is not from the *Superficies* of the *Trunk*, but so deep, as to take with the *Cortical*, the *Lignous Body* into it self; and that not only from its Circumference, but

but (so as to take the *Pith* in also) from its *Inner* or *Central* parts. Divers whereof may commonly be seen to shoot out into the *Pith*; from which *Shoots*, the surrounding and more superiour *Germens* are originated; in like manner as the *Lignous Body* of the *Trunk* is sometimes principally from those *Fibrous Shoots* which run along the *Pith* in the *Root*.

The manner wherein usually the *Germen* and *Branch* are fram'd, is briefly thus: The *Sap* (as is said, *Chap. 3.*) mounting in the *Trunk*, will not only by its length, but by its breadth also, through the *Insertions* partly move. Yet, its *Particles* being not all alike qualified, in different degrees: Some are more gross and sluggish; of which we have the formation of a *Circle of Wood* only, or of an *Annual Ring*: Others are more brisk; and by these we have the

Germen

Germen propagated. For by the vigour of their own motion from the Center, they impress an equal tendency on some of the inner parts of the *Lignous Body* next adjacent to the *Pith*, to move with them. And since the *Lignous Body* is not entire, but frequently disparted; through these dispartments, the said interiour Parts, upon their Nutrition, actually shoot; not only towards the Circumference, so as to make part of a Ring, but even beyond it, in order to the production of a *Germen*. And the *Lignous Body* thus moving, and carrying the *Cortical* along with it; they both make a force upon the *Skin*: Yet their motion being most even and gradual, that force is such likewise; not to cause the least breach of its parts, but gently to carry it on with themselves; and so partly by the extension of its already existent

stent parts, as of those of Gold in drawing of Gilded Wyer ; and partly by the accretion of new ones, as in the enlarging of a Bubble above the Surface of the Water, it is extended with them to their utmost growth. In which growth, the *Germen* being prolonged, and so displaying its several parts, as when a *Prospective* or *Telescope* is drawn out, thus becomes a *Branch*.

The same way as the propagation of the Parts of a *Germen* is contriv'd is its due nutrition also : For being originated from the inner part of the *Lignous Body*, 'tis nourished with the best fermented *Sap* in the *Trunk*, *sc.* that next adjacent to it in the *Pith*. Besides, since all its Parts, upon their shooting forth, divaricate from their perpendicular, to a cross Line, as these and the other grow and thrive together, bind and throng each

each other into a Knot; through which Knot the *Sap* being strain'd, 'tis thus in due moderation & purity delivered up into the Branch.

And for Knots, they are so necessary, as to be seen not only where collateral Branches put forth; but in such Plants also as shoot up in one single *Trunk*; as in *Corn*; wherein, as they make for the strength of the *Trunk*; so by so many percolations as they are Knots, for the transmission of the *Sap* more and more refined towards the Ear. So that the two general uses of Knots are for firmer standing, and finer growth.

Lastly, as the due Formation and Nutrition of the *Germen* are provided for, so is its security also; which both in its position upon the *Trunk*, and that of its Parts among themselves may be observed. The position of its Parts shall be considered in speaking of the Leaf.

Leaf. As to its standing in the *trunk*, 'tis alwayes betwixt the *trunk* or *Elder Branch*, and the *Basis* of the *Stalk* of the *Leaf*; whereby it is not only guarded from the Injuries of any contingent Violence, but also from the more piercing assaults of the Cold, so long till in time 'tis grown, as larger, so more hardy. The manner and uses of the position of every *Germen*, considered as after it becomes a *Branch*, hath already been by the Ingenious Mr. *Sharrock* very well observed; to whom I refer.

Upon the prolongation of the *Germen* into a *Branch*, its *Leaves* are thus display'd. The Parts whereof are substantially the same with those of a *Branch*: For the Skin of the Leaf is only the ampliation of that of the *Branch*; being partly by the accretion of new, & partly the extention of its already existent parts (dilated as in making

king of *Leaf-Gold*) into its present breadth. The Fibres or Nerves dispersed through the Leaf, are only the Ramifications of the *Branch's Wood*, or *Lignous Body*. The *Parenchyma* of the Leaf which lies betwixt the Nerves, and as in Gentlewomens Needle-works, fills all up, is nothing else but the continuations of the *Cortical Body*, or inner part of the *Barque* from the *Branch* into it self, as in most Plants with a fat Leaf, may easily be seen.

The Fibres of the *Leaf* neither shoot out of the *Branch* nor *Trunk*, nor stand in the *Stalk*, in an even Line; but alwayes in either an Angular or Circular posture, and usually making either a Triangle, or a Semi-Circle, or Cord of a Circle; as in *Cycory*, *Endive*, *Cabbage*, &c. may be observed: And if the Leaf have but one main Nerve, that also is postur'd in a Circular or Lunar Figure;

of Vegetables. III

gure ; as in *Mint* and others. The usual number of these Nerves or Fibres is 3, 5, or 7. See the *Figures* from 20, to 29.

The reason of the said Positions of the Fibres in the *Stalk* of the *Leaf*, is for its more erect growth, and greater strength ; which, were the position of the said Fibres in an even Line, and so the *Stalk* itself, as well as the *Leaf* flat, must needs have been defective ; as from what we have said of the Circumferential posture of the *Lignous Body* in the *Trunk*, we may better conceive.

As likewise for the security of its *Sap* : For by this means it is, that the several Fibres, and especially the main or middle Fibre of the *Leaf*, together with a considerable part of the *Cortical Body*, are so disposed of, as to jut out, not from its upper, but its back, or nether plain. Whence the whole
Leaf,

Leaf, reclining backward, becomes a Canopy to them, defending them from those Injuries which from colder Blasts, or an hotter Sun, they might otherwise sustain. So that by a mutual benefit, as these give suck to all the Leaf, so that again protection to these.

These Fibres are likewise the immediate visible Cause of the shape of the Leaf: For if the neathermost Fibre or Fibres in the Stalk be in proportion greater, the Leaf is long, as in *Endive*, *Cycory*, and others: If all of a more equal size, it spreads rounder, as in *Ivy*, *Doves-foot*, *Colts foot*, &c. And although a *Dock-Leaf* be very long, whose Fibres notwithstanding, as they stand higher in the Stalk, are disposed into a Circle all of an equal size; yet herein a peculiar fibre, standing in the Center betwixt the rest, and running through the length of the Leaf, may be observed.

In

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In correspondence also to the size and shape of these Fibres, is the Leaf flat: In that either they are very small, or if larger, yet they never make an entire Circle or Ring; but either half of one, as in *Borage*, or at most three parts of one, as in *Mullen*, may be seen. For if either they were so big, as to contain; or so entire, as perfectly to include a *Pith*, the Energy of the *Sap* in that *Pith*, would cause the said *Lignous Ring* to shoot forth on every side, as it doth in the *Root* or *Trunk*: But the said Fibres being not figur'd into an entire Ring, but so as to be open; on that hand therefore where open, they cannot shoot any thing directly from themselves, because there they have nothing to shoot; and the *Sap* having also a free vent through the said opening, against that part therefore which is thereunto opposite, it can have no force;
I and

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and so neither will they shoot forth on that hand ; and so will they consequently that way only which the force of the *Sap* directs, which is only on the right and left.

The several Fibres in the Stalk, are all inosculated in the Leaf, with very many Sub-divisions ; according as these Fibres are inosculated near, or at, or shoot directly to the edge of the Leaf, is it even or scallop'd. Where these Inosculation are not made, there we have no *Leaves*, but only a company of *Ramulets*, as in *Fennel*.

The Formations and Fouldings of Leaves have one Date, or are the contemporary works of Nature ; each Leaf obtaining its distinct shape, and proper posture together ; both being perfect, not only in the outer, but Central and minutest Leaves, which sometimes are five hundred times smaller than the outer ; both which in the Cau-
tious

tious opening of a *Germen* may be seen.

Nor is there greater Art in the Forms, than in the Foulds or Postures of *Leaves*; both answerably varying, as this or that way they may be most agreeable. Of the *Quincuncial* posture, so amply instanc'd in by the Learned Dr. *Brown*, I shall omit to speak. Others there are, which though not all so universal, yet equally necessary where they are; giving two general advantages to the Leaves, Elegancy and Security, *sc.* in taking up, so far as their Forms will bear, the least room; and in being so conveniently couch'd, as to be capable of receiving protection from other parts, or of giving it to one another; as for instance,

First, There is the *Plain-Lap*, where the Leaves are all laid somewhat convexly one over another, but not plaited; being to

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the length, breadth and number of Leaves most agreeable; as in the Buds of *Pear-tree*, *Plum-tree*, &c. But where the Leaves are not thick set, as to stand in the *Plain-lap*, there we have the *Plicature*; as in *Rose-tree*, *Strawberry*, *Cinquefoyl*, *Burnet*, &c. For the Leaves being here plaited, and so lying in half their breadth, and divers of them thus also collaterally set together, the thickness of them all, and half their breadth, are much alike dimensions; by which they stand more secure within themselves, and in better consort with other *Ger-men-Growths* in the same Truss. If the Leaves be much indented or jagg'd, now we have the same *Duplicature*; where there are divers Plaits in the same Leaf, or Labels of a Leaf, but in distinct Sets, a lesser under a greater; as in *Tansy*, &c. When the Leaves stand not collaterally, but single,
and

and that they are moreover very broad ; then we have the *Multiplification* ; as in *Gooseberries*, *Mallows*, &c. the Plaits being not only divers in the same Leaf, but of the same set continuant, and so each Leaf gather'd up in five, seven, or more Foulds, in the same manner as our Gentlewomens Fans: Where either the thickness of the Leaf will not permit a *flat lap*, or the fewness of their number, or the smallness of their Fibres, will allow the *Rowl*, there this may be observed ; which is sometimes single, as in *Bears-Ears* ; sometimes double, the two *Rowls* beginning at each edge of the Leaf, and meeting in the middle. Which again, is either the *Fore-Rowl*, or the *Back-Rowl*. If the Leaf be design'd to grow long, now we have the *Back-Rowl*, as in *Docks*, *Frimroses*, &c. For the main Fibres, and that with a considerable

part of the *Cortical Body* standing prominent from the *Back-plain* of the Leaf, they thus stand securely couch'd up betwixt the two *Rowls*; on whose security the growth of the Leaf in length depends. But *Bears-Ears*, *Violets*, &c. upon contrary respects, are rowled up inwards. Lastly, there is the *Tre-Rowl*, as in *Fern*; the *Labels* whereof, though all rowled up to the *main Stem*, yet could not stand so firm and secure from the Injuries either of the Ground or Weather, unless to the *Rowls* in breadth, that by the length were super-induc'd; the *Stalk* or *main Stem* giving the same protection here, which in other Plants by the Leaves, or some particular *Mantling*, is contriv'd.

For according to the Form and Foulding of every Leaf or *Germen*, is its protection order'd; about six wayes whereof may be observ'd; *sc.* by *Leaves*, *Surfoyles*, *Interfoyles*,
Stalks,

Stalks, Hoods and Mantlings. To add to what we have above given, one or two Instances. Every Bud, besides its proper Leaves, is covered with divers Leafy *Pannicles* or *Surfoyls*; which, what the Leaves are to one another, are that to them all: For not opening except gradually, they admit not the Weather, Wet, Sun or Ayr, to approach the Leaves, except by degrees respondent, and as they are leisurely inur'd to bear them. Sometimes, besides *Surfoyls*, there are also many *Interfoyls* set betwixt the Leaves, from the Circumference to the Center of the *Bud*; as in the *Hasel*: For the Fibres of these Leaves standing out so far from a plain surface; they would, if not thus shelter'd, lie too much expos'd and naked to the Severities of the Weather. Where none of all the Protections above-named, are convenient, there the Membranes of

the Leaves by continuation in their first forming (together with some Fibres of the *Lignous Body*) are drawn out into so many *Mantles* or *Veins*; as in *Docks*, *Snakeweed*, &c. For the Leaves here being but few, yet each Leaf and its Stalk being both exceeding long, at the bottom whereof the next following Leaf still springs up; the form and posture of all such, as supersedes all the other kinds of protection, and so each Leaf apart is provided with a Veil to it self.

The Uses of the Leaves, I mean in respect of their service to the Plant it self, are these; first, for Protection, which, besides what they give to one another, they afford also to the *Flower* and *Fruit*: To the *Flower* in their Foulds; that being, for the most part, born and usher'd into the open Ayr by the *Leaves*. To the *Fruit*, when afterwards

afterwards they are display'd, as in *Strawberries*, *Grapes*, *Rasps*, *Mulberries*, &c. On which, and the like, should the Sun-Beams immediately strike, especially while they are young, they would quite shrivel them up; but being by the Leaves screened off, they impress the circumjacent Air so far only as gently to warm the said Fruits, and so to promote their Fermentation and Growth. And accordingly we see, that the Leaves above-named are exceeding large in proportion to the *Fruits*: whereas in *Pear-trees*, *Apple-trees*, &c. the *Fruit* being of a solid *Parenchyma*, and so not needing the like protection, are usually equal with, and often wider in Diameter than the *Leaves*.

Another use is for Augmentation; or, the capacity for the due spreading and ampliation of a Tree or Plant, are its Leaves: For
herein

the *Lignous Body* being divided into small Fibres, and these running all along their lax and spongie *Parenchyma*; they are thus a Body fit for the imbibition of *Sap* and easie growth. Now the *Sap* having a free reception into the Leaves, it still gives way to the next succeeding in the *Branches* and *Trunk*, and the voyding of the *Sap* in these, for the mounting of that in the *Root*, and ingress of that in the Mould. But were there no Leaves to make a free reception of *Sap*, it must needs be stagnant in all the parts to the *Root*, and so the *Root* being clogg'd, its fermenting and other Offices will be voyded, and so the due growth of the whole. As in the motion of a Watch, although the original term thereof be the Spring, yet the capacity for its continuance in a due measure throughout all the Wheels, is the free and easie motion of the Balance.

Lastly,

Lastly, As the Leaves subserve the more copious advancement, so the higher purity of the *Sap*: For this being well fermented both in the Root, and in its Ascent through the *Trunk*, and so its Parts prepar'd to a farther separation; the grosser ones are still deposited into the Leaves; the more elaborate and essential only thus supplied to the *Flower*, *Fruit* and *Seed*, as their convenient Aliment. Whence it is, that where the *Flowers* are many and large, into which the more odorous Particles are copiously receiv'd, the green Leaves have little or no smell; as those of *Rose-tree*, *Carnations*, *French-Marigold*, *Wood-bind*, *Tulips*; &c. But on the contrary, where the Flowers are none or small, the green Leaves themselves are likewise of a strong flavour; as those of *Wormwood*, *Tansie*, *Baum*, *Mint*, *Rue*, *Geranium Moschatum*, *Angelica*, and others.

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*An Appendix.**Of Thorns, Hairs and Globulets.*

THorns are of two kinds, *Lignous* and *Cortical*. Of the first are such as those of the *Hawthorn*, and are constituted of all the same substantial Parts whereof the *Germen* it self, and in a like proportion: which also in their Infancy are set with the resemblances of divers minute Leaves. In affinity with these are the *Spiquets* or *Thorny Prickles* upon the Verges and Tops of divers Leaves, as of *Barberry*, *Holly*, *Thistle*, *Furze*, and others; all which I think are
the

the filamentous extremities of the *Lignous Body* sheathed in the *Skin*.

Cortical Thorns are such as those of the *Raspberry Bush*, being not, unless in a most extraordinary small proportion propagated from the *Lignous Body*, but almost wholly from the *Cortical* and *Skin*, or from the *Barque*.

The growth of this *Thorn* may farther argue what in the Second Chapter we supposed; *sc.* That as the proper tendency of the *Lignous Body*, is to ascend, so of the *Cortical* to descend. For as the *Lignous Thorn*, like other Parts upon the *Trunk*, in its growth ascends; this being almost wholly *Cortical*, pointeth downward. The use of *Thorns* the very Ingenious Mr. *Sharrock* observed.

Upon the Leaves of divers Plants two Productions shew themselves, *sc.* *Hairs* and *Globulets*. Of *Hairs*, only one kind is taken notice

tice of, althoegh they are various. Ordinarily they are plain; which when fine and thick set, as on most *Hairy Buds*; or fine and long, as on those of the *Vine*, we call them *Down*.

But sometimes they are not plain, but branched out, from the bottom to the top, reciprocally on every side, in some resemblance to a *Stags-Horn*; as in *Mullen*. And sometimes they are *Astral*, as upon *Lavender*, and some other Leaves, and especially those of *Wild Olive*; wherein every *Hair* rising in one round entire Basis a little way above the Surface of the Leaf, is then disparted, Star-like, into several, four, five or six points, all standing at right Angles with the said perpendicular Basis.

The Uses of Hairs are for Distinction and Protection. That of Distinction is but secondary, the Leaves being grown to a considerable

rable size. That of Protection is the prime, for which they were originally form'd together with the Leaves themselves, and whose service they enjoy in their Infantestate: For the *Hairs* being then in form of a *Down*, alwayes very thick set, thus give that protection to the Leaves, which their exceeding tenderness then requires; so that they seem to be vested with a Coat of *Frieze*, or to be kept warm, like young and dainty Chickens, in Wooll.

Globulets are seen upon *Orach*, both Garden and wild; and yet more plainly on *Mercury* or *Bonus Henricus*. In these, growing almost upon the whole Plant, and being very large, they are by all taken notice of.

But strict Observation discovers, that these *Globulets* are the natural and constant Off-spring of very many other Plants. Both these
Globulets

Globulets, and likewise the diversity of *Hairs*, I find the Learned Mr. *Hook* hath already observed. They are of two kinds; *Transparent*, as upon the Leaves of *Hysop*, *Mint*, *Baume*, and many more: *White*, as upon those of *Germander*, *Sage*, and others. All which, though the naked Eye will discover, yet by the help of Glasses we may observe most distinctly. The use of these we suppose the same with those of the *Flower*, whereof we shall speak.

CHAP. V.

Of the Flower.

VVE next proceed to the *Flower*. The general Parts whereof are most commonly three ; *sc.* the *Empalement*, the *Foliation*, and the *Attire*.

The *Empalement*, whether of one or more pieces, I call that which is the utmost part of the *Flower*, encompassing the other two. 'Tis compounded of the three general Parts, the *Skin*, the *Cortical* and *Lignous Bodies*; each *Empaler* (where there are divers) being as another little Leaf ; as in those of a *Quince-Flower*, as oft as they happen to be overgrown, is well seen.

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As likewise in the *Primrose*, with the green Flower, commonly so call'd, though by a mistake; for that which seems to be the *Flower*, is only the more flourishing *Empalement*, the *Flower* it self being white; but the continuation of all the three aforesaid Parts into each *Empaler*, is discoverable, I think, no where better than in an *Artichoke*, which is a true *Flower*, and whose *Empalers* are of that amplitude, as fairly to shew them all: As also, that the Original of the *Skin* of each *Empaler* is not distinct from that of the rest; but to be all one piece, laid in so many Plaits or Duplicatures as there are *Empalers*, from the outermost to the inner and most central ones.

The Design of the *Empalement*, is to be security and Bands to the other two Parts of the *Flower*: To be their security before its opening, by intercepting all extremities

ties of Weather : Afterwards to be their Bands, and firmly to contain all their Parts in their due and most decorous posture ; so that a *Flower* without its *Empalement*, would hang as uncouth and taudry as a *Lady* without her *Bodies*.

Hence we have the reason why it is various, and sometimes wanting. Some *Flowers* have none, as *Tulips* ; for having a fat and firm Leaf, and each Leaf likewise standing on a broad and strong Basis, they are thus sufficient to themselves. *Carnations*, on the contrary, have not only an *Empalement*, but that (for more firmitude) of one piece : For otherwise, the foot of each Leaf being very long and slender, most of them would be apt to break out of compass ; yet is the top of the *Impalement* indented also ; that the Indentments, by being lapp'd over the Leaves before their expansion, may then

protect them; and by being spread under them afterwards, may better shoulder and prop them up. And if the feet of the Leaves be both long and very tender too, here the *Empalement* is numerous, though consisting of several pieces; yet those in divers Rounds, and all with a counterchangeable respect to each other (which also the Learned Dr. *Brown* observes) as in all *Knapweeds*, and other *Flowers*; whereby, how commodious they are for both the aforesaid ends, may easily be conceiv'd; and well enough exemplified by the Scales of Fishes, whereunto, as to their position, they have not an unapt resemblance.

The *Foliation* also, is of the same substantial nature with the green Leaf; the *Membrane*, *Pulp*, and *Fibres* whereof, being, as there, so here, but the continuation of the *Skin*, the *Cortical* and *Lignous Bodies*. The

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The Foulds of the *Flower* or *Foliation* are various, as those of the green Leaf; but some of them different. The most general are, First, The *Plain Couch*, as in *Roses*, and many other double *Flowers*. then the *Concave Couch*, as in *Blattaria flore albo*. Next the *Plait*, as in some of the Leaves of *Pease-Blooms*, in the Flowers of *Coriander*, &c. which is either single, as in those nam'd; or double, as in *Blew-Bottle*, *Jacea*, and more of that rank. Next, the *Couch* and *Plait* together in the same Flower, as in *Marigolds*, *Daisies*, and all others of an agreeing form: where the first apparent Fould or Composure of the Leaves is in *Couch*; but the Leaves being erect, each likewise may be seen to lie in a double *Plait* within it self. Then the *Rowl*, as in the *Flowers* of *Ladies-Bower*, the broad top of each Leaf being by a double *Rowl* foulded up in-

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wardly. Next, the *Spire*, which is the beginning of a *Rowl*; and may be seen in the Flowers of *Mal-lows*, and others. Lastly, the *Plait* and *Spire* together, where the part analogous to the *Foliation*, is of one piece, the *Plaits* being here laid, and so carried on by Spiral Lines to the top of the *Flower*, as is in divers, and I think in *Convoutulus Doronici folio* more elegantly seen. The reason of all which varieties, a comparative consideration of the several parts of the *Flower* may suggest. He only mentions, that no *Flower* that I find, hath a *Back-Rowl*, as hath the green Leaf, for two Reasons; because its Leaves have not their Fibres standing out much on their back-side, as the green Leaves have; and because of its Attire, which it ever embosoms, and cannot so well do it by a *Back-Rowl*.

The usual Protections of *Flowers*
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ers by the Precedents are express'd
sc. Green Leaves and *Empalements*.
 Some have another more peculiar,
 that is a *double Vail*; as the *Spring-
 Crocus*. For having no *Empale-
 ment*, and starting up early out of
 the Mould, even before its *Green
 Leaves*, and that upon the first o-
 pening of the Spring; lest it should
 thus be quite starved, 'tis born swa-
 th'd up in a double Blanket, or with
 a pair of Sheets upon its Back.

The Leaves of divers *Flowers* at
 their Basis have an *hairy Tuft*; by
 which *Tufts* the Concave of the
Empalement is fill'd up; that, being
 very choice and tender, they may
 thus be kept in a gentle and con-
 stant warmth, as most convenient
 for them.

The Leaves of the *Flower*, though
 they are not hairy all over, yet in
 some particular parts they are of-
 ten set with a fine Downy Velvet;

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that, being by their shape and posture in those parts contiguous to their delicate and tender Attire, they may thus give it a more softly and warmer touch. Thus in the Flower of *Ladies Bower*, those parts of its Leaves which rowl inward, and lie contiguous to the Attire, are Downy; whereas the other parts are plain and smooth: So the Flowers of *Pease*, *Spanish Broom*, *Toad-Flax*, and many others, where contiguous to their Attires, are deck'd with the like *Hairy Velvet*.

As upon the Green Leaves, so upon the Flowers are *Globulets* sometimes seen; as upon the back-side of that of *Enula*. On none more plainly than that kind of *Blattaria* with the white Flower; where they are all transparent, and growing both on the Stalk and Leaves of the Flower, each shewing likewise its *Peduncle* whereon it is erected.

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The use of the *Flower*, or the *Foliation* whereof we now speak, (that is, as to its private service) is for the protection of the Attire; this, as its under, and the *Empalement* as its upper Garments; as likewise of the *Fruit*: The necessity of which Service, in some Cases, by the different situation of the *Flower* and *Fruit*, with respect to each other, is evident; *Apples*, *Pears*, and several other *Fruits*, standing behind or under the *Flower*; but *Cherries*, *Apricots*, and divers others, within it; for these, being of a very tender and pulpous Body, and withal putting forth with the colder part of the Spring, could not weather it out against the Variations and Extremities of the Air, (as those of a more solid *Parenchyma* can) except lodged up within their *Flowers*.

And as the *Flower* is serviceable to the safety of the *Fruit*, so is it
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to its growth; *sc.* in its Infancy, or *Embryo*-estate; for which purpose, as there is a Flower, so that Flower is greater or less, according as the nature of the Fruit to which it belongs, and the plenty of the *Sap* by which the Fruit is fed, doth require. Thus, where the young Fruit is of a solider constitution, and the ascent of the *Sap* less copious, were there here no *Flower* to promote the said ascent thereof into the Fruit (in the manner as is effected by the Green Leaves) it must needs pine and die, or prove less kindly. On the contrary, should the Flower be over-large, it would not only promote the ascent of the *Sap* up to the Fruit, but being as yet over-proportionate to it, would likewise it self exhaust the same *Sap*, as fast as ascendent; like a greedy Nurse, that prepares the Meat for her Child, and then eats it up her self. Thus we see

Apples

Apples and *Pears* with a *Flower* of a moderate fize, like their *Body*; of a middle *Constitution*, and their *Sap* of a middle quantity: But *Quinces*, being more solid, besides that they have as great a *Flower*, the *Impalers* of their *Flower* also thrive so far as to become handſom *Leaves*, continuing also after the *Flower* is fallen, firm and verdent a great while; so long till the *fruit* be able to provide for it self. On the other hand, *Plums* being more tender and Sappy than *Apples* and *Pears*, besides that their *Empalers* are much alike, their *flower* is less. and *Gooseberries* and *Currans*, which are still more Pulpy, and the course of the *Sap* towards them more free, have yet a *flower* far less. And *Grapes*, whose *Sap* is still of quicker Ascent, have scarce any *flower* at all; only some small resemblance thereof, serving just upon the setting of the *fruit*, and no longer.

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The *Attire* I find to be of two kinds, *Seminie* and *Florie*: That which I call *Seminie*, is made up of two general parts, *Chives* and *Semets*, one upon each *Chive*. These *Semets* have the appearance (especially in many *flowers*) of so many little *seeds*; but are quite another kind of Body: For upon enquiry we find, that these *Semets*, though they seem to be solid, and for some time after their first formation, are entire; yet are they really hollow; and their side, or sides, which were at first entire, at length crack asunder: And that moreover the Concave of each *Semet* is not a meer vacuity, but fill'd up with a number of minute Particles, in form of a Powder; which, though common to all *Semets*, yet in some, and particularly those of a *Tulip*, being larger, is more distinctly observable.

These *Semets* are sometimes fastened

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ned so, as to stand 'erect above their *Chive*, as those of *Larks-heel*. Sometimes, and I think usually, so as to hang a little down, in the manner and figure of a *Kidney*; as in *Mallows*. Their Cleft or Crack is sometimes single, but for the most part double: At these Clefts it is that they disburse their Powders; which as they start out, and stand betwixt the two Lips of each Cleft, have some resemblance to the common Sculpture of a *Pomegranate* with its Seeds looking out at the Clefts of its *Rind*: This must be observ'd when the Clefts are recently made, which usually is before the expansion of the *Flower*.

The Particles of these Powders, though like those of Meal or other Dust, they appear not easily to have any regular shape; yet upon strict observation, especially with the assistance of an indifferent
Glas,

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Glass, it doth appear, that they are nothing else but a *Congeries* of so many perfect *Globes* or *Globulets*: That which obscures them; is their being so small. In *Dogs-Mercury*, *Borage*, and very many more Plants, they are extreamly so. In *Mallows*, and some others, more fairly visible.

Some of these Powders are yellow, as in *Dogs-Mercury*, *Goats-Rue*, &c. and some of other colours: But most of them I think are white; and those of yellow *Henbane* very elegant; the dispersed Powders whereof, to the naked eye, are white as Snow; but each *Globulet*, through a Glass, transparent as Crystal; which is not a fallacy from the Glass, but what we see in all transparent Bodies whatsoever, lying in a Powder or small Particles together.

The *Florid Attire*, is commonly

ly known by the blind and rude Name of *Thrums*; as in the Flowers of *Marigold*, *Tansie*, &c. How adequate its imposition is, observation will determine: For the several *Thrums* or rather *Suits*, whereof the *Attire* is made up, however else they may differ in various Flowers, in this agree, that they are never consistent of more than one, sometimes of two, and for the most part of three pieces (for which I call them *Suits*) and each piece of a different, but agreeable and comely form.

The *outer part* of every *Suit*, is its *Floret*: whose *Body* or *Tube* is divided at the top (like that of the *Cowslip*) into divers distinct Leaves; so that a *Floret* is the Epitome of a *flower*; and is all the *flower* that many Plants, as *Mugwort*, *Tansie*, and others, have. What the Learned Dr. *Brown* observeth of the number Five as to the

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the Leaves of the *flower*, is still more universally holding in these of the *Floret*.

Upon the Expansion of the *Floret*, the next part of the *Suit* is from within its *Tube* brought to light; which we may (with respect to that within it) call the *Sheath*: For this also, like the *Floret*, is a concave Body; in its shape very well resembling the *Fistulous Pouches* of *Wake-Robin*, or of *Dragon*.

The *Sheath*, after some time, dividing at the top, from within its Concave, the third and innermost part of the *Suit*, *sc.* the *Blade* advanceth and displayes it self. This part is not hollow, as the other two, but solid; yet at its point, not originally, but after some time, is evermore divided into two halves.

Upon the division of the said Point, there appears, as upon the opening

opening of a *Semet*; a Powder of *Globulets*, which before lay enclosed up within its Clefts; and are of the same nature with those of a *Semet*, though not so copious: So that all *flowers* have their *Powders* or *Globulets*. The whole *Attire* may in *Knapweed*, *Blew-bottle*, &c. be observed.

The use of the *Attire*, how contemptibly soever we may look upon it, is certainly great. And though for our own use we value the *Leaves* of the *Flower*, not the *Foliation*, most; yet of all the three *Parts*, this in some respects is the choicest, as for whose sake and service the other two are made. The use hereof, as to *Ornament* and *Distinction*, is unquestionable; but is not all. As for *Distinction*, though by the help of *Glasses* we may make it to extend far; yet in a *passant view*, which is all we usually make, we cannot

so well. As for Ornament, and particularly in reference to the *Se-mets*, we may ask, If for that merely these were meant, then why should they be so made as to break open, or to contain any thing within them? Since their Beauty would be as good as if they were not hollow, and is better before they crack and burst open, than afterwards.

A farther use hereof therefore we must acknowledge, and may observe; and that is for food; for Ornament and Distinction to us, and for Food to other Animals. I will not say, but that it may serve even to these for Distinction too, that they may be able to know one Plant from another, and in their flight or progress settle where they like best; and that therefore the varieties of these small parts are many, and well observed by them, which we take no notice of: Yet
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the finding out of Food is but in order to enjoy it: Which, that it is provided for a vast number of little Animals in the *attires* of all *Flowers*, observation perswades us to believe. For why else are they evermore here found? Go from one Flower to another, great and small, you shall meet with none untaken up with these Guests. In some, and particularly the *Sun-flower*, where the parts of the *Attire*, and the *animals* for which they provide, are larger, the matter is more visible. We must not think, that God Almighty hath left any of the whole Family of his Creatures unprovided for; but as the Great Master, some where or other carveth out to all; and that for a great number of these little Folk, He hath stored up their peculiar provisions in the *Attires* of *Flowers*; each *Flower* thus becoming their Lodging and their

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Dining-Room, both in one.

Wherein the particular parts of the *Attire* may be more distinctly serviceable, this to one Animal, and that to another, I cannot say: Or to the same Animal, as a *Bee*, whether this for the *Honey*, another for their *Bread*, a third for the *Wax*: Or whether all only suck from hence some *Juice*; or some may not also carry some of the Parts, as of the *Globulets*, wholly away: Or lastly, what may be the primary and private use of the *attire* (for even this above said, though great, yet is but secondary) I now determine not.

CHAP.

CHAP. VI.

Of the Fruit.

THe general composition of all *Fruits* is one, that is, their *Essential* and truly *Vital Parts*, are in all the same, and but the continuation of those which in the other *Parts* of a *Vegetable*, we have already observed: Yet because by the different *Constitutions* and *Tinctures* of these *Parts*, divers considerably different *Fruits* result; I shall therefore take a particular view of the more known and principal of them, *sc. Apples, Pears, Plums, Nuts* and *Berries*.

An *Apple*, if cut traverse, appears constituted of four distinct

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Parts, the *Pill*, the *Parenchyma*, *Branchery* and *Coare*. The *Pill* is only the spreading and dilatation of the skin, or utmost part of the *Barque* in the *Branch*. The *Parenchyma*, when full ripe, is a tender delicate Meat: Yet as the *Pill* is but the continuation of the utmost part of the *Barque*; so is this but the continuance and ampliati-on, or (as I may call it) the swelth and superbience of the *In-ner part* thereof; which upon ob-servation of a young and Infant-*Apple* especially, is evident. Thus we see the *Pith*, which is often tough, in many Roots, as *Parsneps*, *Turneps*, &c. is tender and edible. So here, the *Parenchyma*, though originally no more than the *Barque*, yet the plenty and purity of its *Sap* being likewise effectual to the fulness and fineness of its growth, it thus becomes a soft and tender meat. The *Branchery* is
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nothing else but the Ramifications of the *Lignous Body* throughout all the parts of the *Parenchyma*; the greater Branches being likewise by the *Inosculation*s of the less (as in the Leaf) united together. The main Branches are usually fifteen; ten are spread and distributed through the *Parenchyma*, all enarching themselves towards the *Cork* or *Stool* of the *Flower*; the other five running from the *Stalk* in a directer Line, at last meet the former at the said *Cork*, and are there osculated with them. These five are originated from one; which running along the Center of the *Stalk*, and part of the *Parenchyma* of the *Fruit*, is therein at last divided. To these the Coats of the *Kernels* are fastned; so that whereas these Branches were originally all extended even beyond the *Fruit*, and inserted into the *Flower* for the due growth thereof;

the *Fruit* afterwards growing to some head, and so intercepting and preying upon the Aliment of the *Flower*, starves that, and therefrom supersedes the service of the said Branches to it self, ten for its *Parenchyma*, and five for its *Seed*. The *Coar* is originated from the *Pith*; for the *Sap* finding room enough in the *Parenchyma*, through which to dispencc it self all abroad, quits the *Pith*, which thereby hardens into a *Coar*. Thus we see the *Insertions*, although originate from the *Cortical Body*, yet their Parts being, by the *Inosculation*s of the *Lignous*, so much compress'd and made to co-incide together, they become a Body very compact and dense. And in the *Barque* we see the same effect by *arefaction* only, or a meer *vojdance* of the *Sap*; the *Inner Part* whereof, though soft and sappy, yet its superficial *Rind* is often so hard and smooth, that

that it may be fairly writ upon.

In a *Pear* there are five distinct Parts, the *Pill*, the *Parenchyma*, *Branchery*, *Calculary* and *Acetary*. The three former are here and in an *Apple* much alike; saving that here the *Inner* or *Seed-Branches* are ordinarily ten. The *Calculary* (most observable in rough-tasted, or *Choak-Pears*) is a congeries of little stony Knots: They are many of them dispersed throughout the whole *Parenchyma*; but lying more continuous and compact together towards the Center of the *Pear*, surround the *Acetary* there in a somewhat Globular Form. About the *Stalk* they stand more distant; but towards the *Cork* or *Stool* of the *Flower*, they still grow closer, and there at last gather (almost) into the firmitude of a *Plum-stone* it self. Within this lies the *Acetary*: 'tis of a soure taste, and by the bounding of the *Calculary* of

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of a *Globular Figure*. 'Tis a simple Body, having neither any of the *Lignous* branched in it, nor any Knots. It is of the same substantial nature with the *Parenchyma*; but whether it be absolutely one with it, or be derived immediately from the *Pith*, my Enquiries yet made, determine not.

The Original of the *Calculary* I seem to have neglected: But hereof we may here best say, that whereas all the other Parts are Essential and truly *Vital*, the *Calculary* is not; but that the several Knots whereof it consists, are only so many meer Concretions or Precipitations out of the *Sap*; as in *Urines*, *Wines*, and other *Liquors*, we often see. And that this *Precipitation* is made by the mixture and re-action of the *Tinctures* of the *Lignous* and *Cortical Bodies* upon each other: Even as all *Vegetable Nutrition* or *Fixation* of

of Parts is also made by the joynt efficiency of the two same Tinctures, as hath been said. Hence we find, that as the *Acetary* hath no Branches of the *Lignous Body*, so neither hath it any Knots. Hence likewise it is, that we have so different and contrary a taste in the *Parenchyma* beyond the *Calculary*, from that in the *Acetary*; for whereas this is soure, that, wherein the said *Precipitations* are made, is sweet; being much alike effect, to what we find in mixing of *Corals*, &c. with *Vinegar* or other *acid Liquor*.

In a *Plum* (to which the *Cherry*, *Apricot*, *Peach*, *Walnut*, &c. ought to be referr'd) there are four distinct Parts, the *Pill*, the *Parenchyma*, *Branchery* and *Stone*. The *Pill* and *Parenchyma* are, as to their Original, with those of an *Apple* or *Pear* both alike: As like, wise the *Branchery*; but differently

rently ramified. In *Plums* (I suppose all) there are five main *Out-Branches*, which run along the Surface of the *Stone* from the *Basis* to the point thereof, four of them by the one Ridge. and one by the other opposite to it. In an *Apricot* there is the same number, but the single Branch runs not upon the Surface, but through the Body of the *Stone*. There are likewise two or three smaller Branches, which run in like manner under the other Ridge for some space, and then advancing into the *Parenchyma*, therein disperse themselves: These latter sort in *Peaches* are numerous throughout: But notwithstanding the different disposition of the Branches of the *Fruits* aforesaid; yet is there one Branch dispos'd in one and the same manner in them all: The entrance hereof into the *Stone* is at its *Basis*; from whence running through
its

its Body, and still inclining or arching it self towards its Concave, is at last about its Cone thereinto emergent, where the Coats of the *Seed* are appendent to it. Of the *Seed-Branch* 'tis therefore observable that after its entrance into the *Fruit*, 'tis alwaies prolonged therein to a considerable length; as is seen not only in *Apples*, &c. where the *Seed* stands a good distance from the *Stalk*; but in *Plums* likewise, where it stands very near it; in that here the *Seed-Branch*, as is said, never strikes through the *Stone* into the Coats of the *Seed* directly, but about its Cone or remoter end. The *Stone*, though it seem a simple Body, yet it is compounded of different ones: The Inner Part thereof, as it is by far the thinnest, so is it the most dense, white, smooth and simple. The Original is from the *Pith*; difficult, but curious to observe: For the
Seed-

Seed-Branch, not striking directly and immediately quite through the *Basis* of the *Stone*, but in the manner as is above described, carries a considerable part of the *Pith*, now gather'd round about it, as its *Parenchyma*, along with it self; which, upon its entrance into the concave of the *Stone* about its farther end, is there in part spread all over it, as the *Lining* thereof. The outer and very much thicker Part consisteth partly of the like *Precipitations* or concrete Particles, as in a *Pear*, being gathered here much more closely, not only to a Contiguity, but a coalition into one entire Stone; as we see in *Pears* themselves, especially towards the *Cork*, they gather into the like Stoniness; or as we see a *Stone*, *Mineral* or *Animal*, oftentimes the product of accumulated *Gravel*: But as the *Parenchyma* is mixed with the Concretion in the *Calculus*,
lary,

lary, so is it also, though not visibly, with these in the *Stone*, the ground of the *Stone* being indeed a perfect *Parenchyma*; but by the said Concretions so far alter'd, as to become dry, hard and undistinguishable from them.

In a *Nut* (by which an *Ackorn* is analogous) there are three general Parts, the *Cap*, *Shell* and *Pith*. The *Cap* is constituted of a *Pill* and *Parenchyma* derived from the *Barque*, and *Ramulets* from the *Lignous Body* of the *Branch*. The *Shell* likewise is not one simple Body, but compounded. The Superficial Part thereof is originated from the *Pill* or *Skin* of the *Cap*, from the inside whereof it is in a Duplicature produc'd and spread over the *shell*: which, if you look at the *Basis* of the *shell*, is farther evident; for that being continuous with the *Parenchyma* of the *Cap*, without the interposure
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of the *Skin*, the said superficial Part is there wanting. The thicker and inner part of the *shell* consisteth of the same *Parenchyma* as that of the *Cap*, with a congeries of *Precipitations* filled up, as in a Stone. And as the *Lignous Body* is branched in a Stone, so, with some difference, in a *Shell*. The *Outer Branches* or *Ramulets* are numerous, each issuing out of the *Parenchyma* of the *cap*, and entring the *Shell* at the Circumference of its *Basis*, and so running betwixt its superficial and inner parts towards its *cone*, in a Round. The *Inner* or *Seed-Branch* is single, entering in, as do the other, not at the *Basis* of the *Shell*, but at the center thereof; from whence it runs, not through the *Shell*, as in *Plums* through the *Stone*; but through the *Pith*, as far as the *cone*, where the Coats of the *Seed* hang appendent to it. The *Pith*, whether
deri-

derived from the same part both in name and nature in the *Branch* and *Stalk*, or from the *Cortical Body*, I yet determine not.

A *Berry*, as a *Gooseberry* (to which *Curran*s, *Grapes*, *Hipp*s, &c. are to be referr'd) consisteth, besides the *Seed*, of the three general Parts, *Pill*, *Parenchyma* and *Branchery*: The *Pill* is originated as in the foregoing Fruits. The *Parenchyma* is double, as likewise in some other *Berries*: The *outer* is commonly, together with the *Pill*, call'd the *Skin*, and is that part we spit out, being of a soure taste. As the *Pill* is originated from the *outer*, so this from the *inner part* of the *Barque*; and accordingly the Pores thereof may be observed plainly of a like shape with those both of the *Cortical Body* and *Pith*. The *inner* is of a sweet taste, and is the part we eat: It is of a constitution so laxe and tender,

der, as it would seem to be only a thicker or jellied Juice ; although this likewise be a true *Parenchyma*, something like that of an *Orange* or *Limon*, with its Pores all fill'd up with Liquor. The *Branchery* is likewise double: The *Exterior* runs betwixt the *Pill* and outer *Parenchyma* in arched Lines , from the *Stalk* to the *Stool* of the *Flower*. These outer Branches, though of various number at the *Stalk*, yet at the *Cork* are usually ten principal ones; five for the five Leaves of the *Flower*, and five for the *Chives*. The inner main Branches are two, diametrically opposite to each other, and at the *Cork* with the other inosculated. From these two are branched other smaller, every one having a *Seed* appendent to it, whose Coats it entrencheth by a double Filament, one at the *Basis*, the other at the *Cone*. They are all very white and turgent,

gent, and by a flaunt'cup, may be observ'd concave; thus representing themselves analogous to so many true *spermatick Vessels*.

The Uses of *Fruits* are for *Man*, (sometimes also other *Animals*, as are *Akerns* and *Haws*) and for the *Seed*. For *Man*, they are so variously desirable, that till our Orchards and Store-Chambers, *Confectioners* Stores and *Apothecaries* Shops, our Ladies Closets, their Tables or Hands are empty of them, I shall not need to enquire for what. If it be asked, how the Fruit becomes, generally above all the other Parts, so pleasant a Meat? It is partly from the *Sap*, the grosser portion thereof being deposited in the Leaves, and so the purer hereunto reserved; partly from the Globular Figure of the Fruit; for the *Sap* being thus in a greater quantity herein, and in all parts equally diffus'd, the Con-

coction hereof is with greatest advantage favoured and promoted. Wherefore all Fruits which we eat raw, how small soever, are of a Globular form, or thereunto approaching; and the nearer, the delicates; amongst *apples*, the *Pep-pin*; amongst *Pears*, the *Burgundian*; and amongst all Fruits, the *Grape*; and amongst *Grapes*, the roundest, are of all the most dainty.

The visible cause of this Globular Figure, is the *Flower*; or the Inosculation of all the main Branches at the *Stool* of the *Flower*; and upon the fall of the *Flower*, the obtuseness, and with Wind and Sun, as it were the searing of their several ends: For thus the *Sap* entering the *Fruit*, being not able to effect, either a Disunion, or a shooting forth of the said Branches, and so to carry on their growth in length; they must thus of necessity
be

be enarch'd, and with the *Parenchyma* more and more expand themselves. Whereas were they dispos'd and qualified otherwise, than as is said, instead of forming a Fruit within bounds, they would run out into all extravagance, and even into another little Tree or Leafy growth.

To the *Seed*, the *Fruit* is serviceable; First, in order to its being supply'd with a due and most convenient *Sap*, the greater and less elaborated part thereof being, in its passage towards the *Seed*, thereinto received; the *Fruit* doing the same office to the *Seed*, which the *Leaves* do to the *Fruit*; the *Sap* in the *Fruit* being in a laxer comparison, as the *Wine*; and that for the *Seed*, a small part of the highest Spirit rectified from it.

So likewise for its Protection, in order to the prosperous carrying on and perfecting of its generati-

on, and security being perfected. Which protection it gives not only to the Seminal *Sap* and *Seed* it self, but alwaies also to its *Seed-Branch*. Thus we see an *Apple*, besides that it is it self of ample compass, for the sake of its *Seed*, hath likewise its *coar*; as if it were not sufficient, that the Walls of their Room are so very thick, unless also wainscotted. In a *Pear* again, where the *Parenchyma* is of less compass than that of an *Apple*, to what protection this affords, that of the *Calculary* is super-added. But in a *Plum*, where the *Parenchyma* is exceeding tender, and in a *Peach*, which hangs late, and till Autumn Frosts approach, we have not only the Rubbish of a *Calculary*, but stout Stone-Walls. Within which also, not only the *Seed* it self, but the *Seed-Branch* is evermore immur'd. Lastly, in a *Nut*, where the *shell* being not surrounded

ed

ed with a *Parenchyma*, that protection is wanting without, 'tis answer'd by an ample *Pith* within it ; and the *seed-Branch* likewise included , not meerly in the Body of the Shell, as in a *Plum*, but within the *pith* it self. So necessary is this design, that what the Hen by Incubation or Hovering, is to the Egg or Chick ; that the whole *Fruit*, by comprehension, is to the *Seed*.

CHAP. VII.

Of the Seed.

AS the Original, so the Ultimate end & Perfection of *Vegetation* is the *Seed*. How it is the former, and in its state apt for *Vegetation*, hath already been seen. How the latter, and in its state of Generation, we shall now lastly enquire. In doing which, what in the other state was either not distinctly existent, or not so apparent, or not so intelligible, will occur.

The two general Parts of the *Seed* are its *Covers* and *Body*. The *Covers* in this estate are usually
• four;

four; the outmost we may call the *Cafe*: 'Tis of a very various form; sometimes a *Pouch*, as in *Nasturtium*, *Cochlearia*; a *Cod*, as in all *Pulse*, *Galega*; sometimes not entire, but parted, or otherwise open, as in *Sorrel*, *Knotgrafs*, with many other forms; I think alwaies more heterogeneous to that of the *Seed*, by which it differs from the proper *Coats*. To this the *Caps* of *Nuts*, and the *Parenchyma's* of *Fruits* are analogous.

The two next are properly the *Coats*: In a *Bean* especially, and the like; from whence to avoyd Confusion, the denomination may run common to the responding *Covers* of other *Seeds*. The *Colour* of the outer is of all degrees, from *White* to the *Blackness* of *Jett*: Its *Figure* sometimes *Kidney'd*, as in *Alcæa*, *Behen*, *Poppy*; triangular, as in *Polygonatum*, *Sorrel*; triangular spherical, in *Mentha*,

tha, *Melissä*; circular, in *Leucoium*, *Amaranthus*; globular, in *Napus*, *Asperula*; oval, in *Speculum Veneris*, *Tithymalus*; half Globe, in *Coriander*; that which we take for one single round *Seed*, being a Conjugation of two; half Oval, in *Anise*, *Fennel*; Hastal, in *Lactuca*; Cylindrical, as, if I mistake not, in *Jacobæa*; Pyramidal, in *Geranium*, *Althææ Fol.* with many other differences: But the Perfection of one or two of the said Figures lieth in the *Case*: So that as all Lines and Proportions are in the *Flower*, so all Regular Figures in the *Seed*, or rather in its *Covers*.

'Tis sometimes glistering, as in *Speculum Veneris*; Rough-cast, in *Catanance*; Studded, in *Behen*, *Blattaria*; Tavous, in *Papaver*, *Antirrhinum*, *Lepidium annuum*, *Alcea Vesicaria*, *Hyosciamus*, and many more, before the *Seeds* have
lain

lain long by ; Pounted, in *Phalangium Cretæ*, *Lithospermum* ; Ramified, in *Pentaphyllum fragiferum*, *Erectum majus*, resembling the Fibres of the Ears of the Heart ; some just *Quinquenervial*, as in *Anisum*, and many more, the *Lignous Body* being in five main Fibres branched therein.

The Covers of not only *Quince-Seeds*, and those of *Psyllium* (more usually taken notice of) but those also of *Horminum*, *Nasturtium*, *Eruca*, *Camelina*, *Ocymum*, and divers others, have a *Mucilage* ; which, though it be not visible when the Seeds are thoroughly dry ; yet lying a while in some warm Liquor, or only on the Tongue, it swells more or less, and upon them all fairly shews it self. On that of *Ocymum* it appears grayish ; on the other, transparent ; and on that of *Nasturtium Hortense* very large ; even emulous of the inner Pulp surrounding

rounding a *Gooseberry-seed*. The putting of *Clary-seed* into the Eye, may have been brought into use from this *Mucilage*, by which alone it may become Medicinal. And thus far of the *Superficies*.

The nature of the outer Coat is various, *Membranous*, *Cartilaginous* and *Stony*; the like *Precipitations* being sometimes made herein, as in a Stone or Shell; as in that of the Seeds of *Carthamum*, *Lithospermum*, and others. The Designment hereof, being either with respect to the *Seed* in its state of Generation; as where the Case is either wanting, or at least insufficient of it self, there for its due protection and warmth; or, in its state of *Vegetation*, for the better Fermenting of its Tinctures and Sap; the Fermentations of some *Seeds* not well proceeding, unless they lie in their Stony Casks in the Mould, like Bottled Liquors in Sand. All

of Vegetables. 173

All *Seeds* have their outer Co-
vers open ; either by a particular
Foramen, as in *Beans*, and other
Pulse, as is said ; or by the break-
ing off of the *Seed* from its *Pedun-
cle* or *Stool*, as in those in *Cucumber*,
Cycory ; or by the entering and
passage of a *Branch* or *Branches*, not
only into the Concave thereof near
the Cone , but also through the
Cone it self ; as in *Shells* and
Stones.

For the sake of this *aperture* it is,
that *Akerns*, *Nuts*, *Beans*, *Cu-
cumbers*, and most other *Seeds*, are
in their formation so placed, that
the *Radicle* still standeth next to
it ; that, upon *Vegetation*, it may
have a free and ready passage into
the Mould.

The Original of the outer Coat,
though from Parts of the same sub-
stantial nature , yet is differently
made. In a *Plum*, the *Seed-Branch*
which runs, as is described, through
the

the Stone, is not naked, but, as is said, invested with a thin *Parenchyma*, which it carries from the Stalk along with it; and which, by the *Ramification* of the said *Branch* within the Stone, is in part dilated into a Coat. That of a *Bean* is from the *Parenchyma* of the Cod; the superficial part of which *Parenchyma*, upon the large *peduncle* of the *Bean* becoming a thin Cuticle, and upon the *Bean* it self a *cartilaginous* Coat.

The Original of the inner Coat of the *Bean* is likewise from the inner part of the said *parenchyma*; which first is spread into a long Cake, or that which with the *seed-Branch* maketh the *peduncle* of the *Bean*; under which Cake, there is usually a black part or spot; by the length of which, the inner part of the Cake is next inserted into the outer Coat, and spread all over the Concave thereof.

This

This inner Coat, though when the *Seed* is grown old and dry, 'tis shrunk up, and in most Seeds so far as scarcely to be discern'd; yet in its first and juvenile Constitution, is a very Spongy and Sappy Body; and is then likewise (as the *Womb* in a pregnant Animal) in proportion very thick and bulky; in a *Bean*, even as one of the *Lobes* it self: And in a *Plum* or *apricot*, I think I may safely say, half an hundred times thicker than afterwards, when it is dried and shrunk up; and can scarcely be distinguished from the upper Coat. Upon which Accounts it is, in this estate, a true and fair *Parenchyma*.

In this Inner Coat in a *Bean*, the *Lignous Body* or *Seed-Branch* is distributed: Sometimes, as in *French-Beans*, throughout the whole Coat; as it is in a *Leaf*: In the *Great Garden-Bean*, upon
its

its first entrance, it is bipartite, and so in small Branches runs along the Circumference of the Coat, all meeting and making a kind of Reticulation against the Belly of the *Bean*. In the same manner the main Branches in the outer Coat of a *Kernel*, circling themselves on both hands from the place of their first entrance, at last meet, and mutually inosculate.

So that all the Parts of a *Vegetable*, the *Root*, *Trunk*, *Branch*, *Leaf*, *Flower*, *Fruit* and *Seed*, are still made up of two substantially different Bodies.

And as every Part hath two, so the whole *Vegetable* taken together, is a composition of two only, and no more: All properly Woody Parts, Strings and Fibres, are one Body: All simple *Barques*, *Piths*, *Parenchyma's* and *Pulps*, and as to their substantial Nature, *Pills* and *Skins* likewise, all but one
Body:

Body : the several Parts of a *Vegetable* all differing from each other, only by the various Proportions and Mixtures, and variously sized Pores of these two Bodies.. What from these two general Observations might reasonably be inferr'd, I shall not now mention.

The fourth and innermost Cover we may call the *Secondine* ; the sight whereof, by cutting off the Coats of an *Infant-Bean*, at the Cone thereof in very thin Slices, and with great Caution, may be obtain'd. While unbroken, 'tis transparent ; being torn and taken off, it gathers up into the likeness of a Jelly, or that we call the *Tre-dle* of an Egg, when over-boyl'd. This *Membrane* in larger or elder *Beans*, is not to be found distinct ; but becomes as it were the Lining of the inner Coat: But (as far as our Enquiries yet discover) it may in most other *Seeds*, even full grown, be
N distinctly

distinctly seen ; as in those of *Cucumber* , *Colocynthis* , *Burdock* , *Carthamum* , *Gromwel* , *Endive* , *Mallows* , &c. 'Tis usually so very thin , as in the above-nam'd , as very difficultly to be discover'd. In some *Kernels* , as of *Apricots* , 'tis very thick ; and in some other Seeds. That all these have the Analogy of one and the same Cover, which I call the *Secondine* , is most probably argu'd from their alike Natures ; being all of them plain simple *Membranes* , with not the least Fibre of the *Lignous Body* or *Seed Branch* , visibly distributed in them ; as also from their *Contexture* , which is in all of them more close.

The Concave of this *Membrane* is filled with a most transparent Liquor , out of which the Seed is formed ; as in cutting a *petite* and *Infant-Bean* , may be seen ; and yet better in a young *Walnut*. In

Beans

Beans I have observed it to turn, upon boyling, into a tender white *coagulum*.

Through this *Membrane*, the *Lignous Body* or *Seed-Branches* distributed in the inner Coat, at last shoot downright two slender *Fibres*, like two Navles, one into each *Lobe* of the *Bean*. The places where the said *Fibres* shoot into the *Lobes*, are near the *Basis* of the *Radicle*; and by their Blackishness well enough remark'd: but the *Fibres* themselves are so very small, as scarcely to be discern'd: Yet in a *Lupine*, of the larger kind, both the places where the Navel-*Fibres* shoot into the *Lobes* (which here from the *Basis* of the *Radicle* is more remote) and the *Fibres* themselves, are fairly visible. For the *Seed-Branch*, upon its entrance into the Coat of the *Lupine*, is presently divided into two *main Branches*, and those two into other less;

whereof some underly, others aloft, run along the Coat, and towards its other end meet and are inosculated; whereabout two opposite, shallow, round, and most minute Cavities, answerable to two Specks of a *cartilaginous* gloss, one in either *Lobe*, may be observed; which Specks are the ends of the said *Navel-Fibres*, upon the ripening of the *Seed* there broken off. These Fibres, from the Superficies of each *Lobe*, descend a little way directly down; presently, each is divided into two Branches, one distributed into the *Lobes*, the other into the *Radicle & Plume*, in the manner as in the first Chapter is describ'd. And thus far the History. I shall now only with a brief account of the *Generation* of the *Seed*, as hereupon dependent, conclude this Discourse.

Let

Let us say then, that the *Sap* having in the *Root*, *Trunk* and *Leaves*, passed divers Concoctions and Separations, in the manner as they are said to be perform'd therein; 'tis now at last, in some good maturity, advanced towards the *Seed*.

The more copious and cruder part hereof is again seperated by a free reception into the *Fruit*, or other Part analogous to it: being either sufficiently ample to contain it, or at least laxe enough for its transpiration, and so its due discharge. The more Essential part is into the *Seed-Branch* or Branches entertain'd; which, because they are evermore of a very considerable length, and of a Constitution very fine, the said *Sap* thus becomes in its Current therein, as in the *Spermatick Vessels*, still more mature.

In this mature estate, from the *seed-Branch* into the Coats of the *seed*, as into the Womb, 'tis next delivered up. The meaner Part hereof again, to the outer, as *aliment* good enough, is supplied. The finer part is transmitted to the Inner; which, being, as is said, a *Parenchymous* and more spacious Body, the *Sap* therefore is not herein, as in the outer, a meer *aliment*; but in order to its being, by Fermentation, farther prepared.

Yet the outer Coat, being on the contrary hard and dense; for that reason, as it admitteth not the Fermentation of the *Sap* so well within it self; so doth it the more promote and favour it in the Inner, being Bounds both to it and its *Sap*; and also quickneth the process of the whole Work in the formation of the *Seed*.

Nor

Nor doth the outer Coat, for the same reason, more promote than declare the purity of the *Sap* now contained in the Inner: For being more hard and dense, and so not perspirable, must needs suppose the Parts of the *Sap* encompassed by it, since thus incapable of any evacuation, to be therefore all, so choice, as not to need it.

The *Sap* being thus prepared in the inner Coat, as a Liquor now apt to be the *Substratum* of the future *Seed-Embryo*, by fresh supplies, is thence discharg'd; yet that it may not be over-copious; which, because of the laxity of the Inner Coat from whence it issues, it might easily be; therefore as the said inner Coat is bounded without by the upper Coat, so by the *Secundine* or *Membrane* is it bounded within; through which *Membrane*

the *Sap* being filtr'd, or, as it were, transpiring, the deposite hereof, answerable to the *Colliquamentum* in an Egg, or to the *semen Mulibre*, into its Concave at last is made.

The other Part of the purest *sap* embosom'd in the Ramulets of the *seed-Branch*, runs a Circle, or some progress therein; and so becomes, as the *Semen Masculinum*, yet more elaborate.

Wherein also, lest its Current should be too copious or precipitate, by their co-acture and divarication where they are inosculated, it is retarded; the noblest portion only obtaining a pass.

With this purest *sap*, the said *Ramulets* being supplied, from thence at last, the *Navel-Fibres* shoot (as the privitive *Artery* into the

the *Colliquamentum*) through the *Secondine* into the aforesaid Liquor deposited therein.

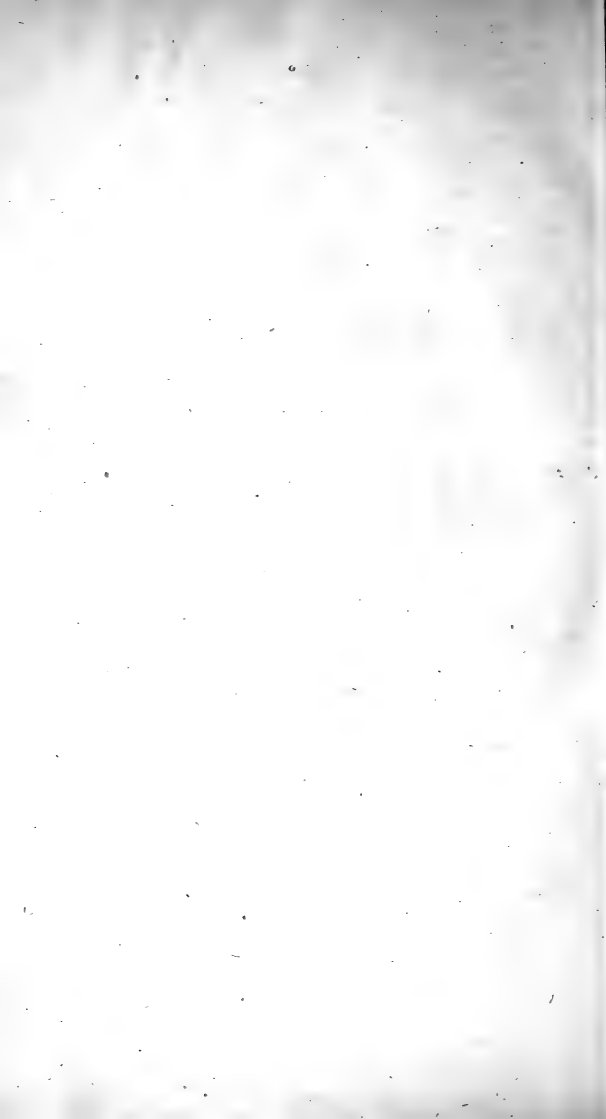
Into which Liquor, being now shot, and its own proper Sap or Tinctures mixed therewith, it strikes it thus into a *Coagulum*; or, of a Liquor, it becomes a Body consistent and truly *Parenchymous*; and the supply of the said Liquor still continu'd, and the shooting of the Navel-Fibres, as is above described, still carried on, and the therewith said *Coagulation* or *Fixation* likewise.

And in the Interim of the *Coagulation*, a gentle *Fermentation* being also made, the said *Parenchyma* or *Coagulum* becometh such, not of any Constitution indifferently, but is thus raised (as we see Bread in Baking) into

into a *Congeries* of *Fixed Bubbles*: For such is the *Parenchyma* of the whole Seed.

F I N I S.





THE
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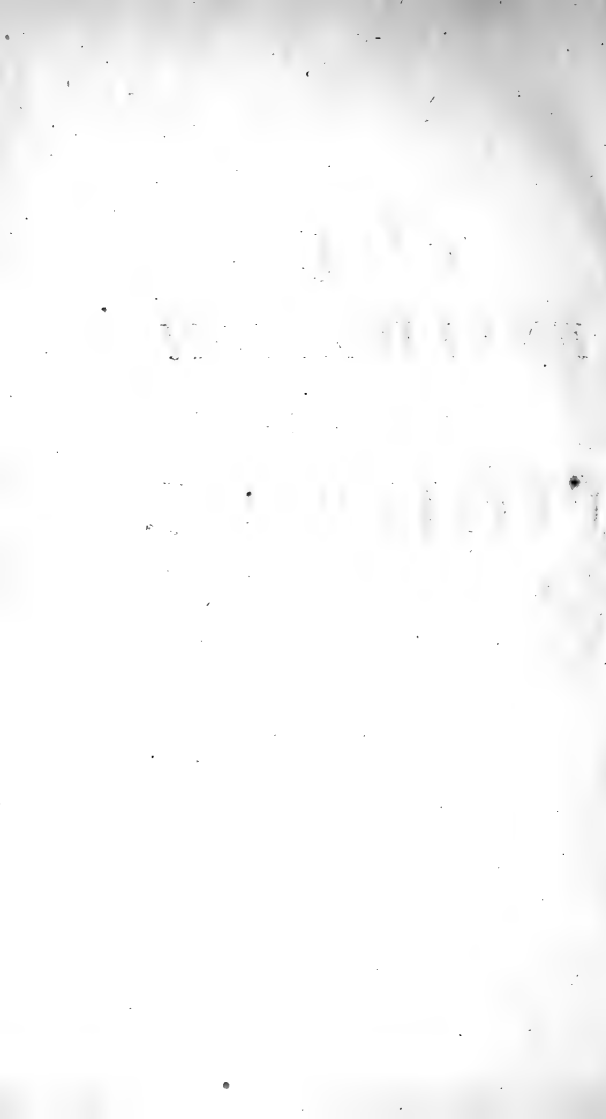


Fig. 1.

Sheweth a Bean with the two Lobes laid open somewhat wider than the Parts, without a Rupture, will well bear, for the better sight of that Part which lieth between them.

aaaa The two Lobes.

AA Their contiguous Flats.

b The Radicle.

c The Plume.

dd One of the Cavities wherein the Plume lieth.

Fig.

Fig. 2.

aaaa The *Parenchyma*.

eeee The *seminal Root* distributed throughout the *Parenchyma* of either *Lobe*.

b The *Radicle*, with the *seminal Root* running through it in one Trunk to the Point thereof.

c The *Plume*, with the *Distributions* of its *Inner Body* continued from the *seminal Root* of either *Lobe*.

xx The oblique *Insertion* of the two grand Branches of the *Lobes* into the Trunk of the *Radicle*.

Fig.

Fig. 3.

The Lobe of a Bean cut athwart.

aaa The convex or external part thereof.

bbb The concave side out of sight.

cccc The Extremities of the Branches of the *seminal Root*, as they appear like so many small Specks in the traverse Cut.

O *Fig.*

Fig. 4.

The Plumè cut athwart.

The black Specks represent the Branches of the *seminal Body* thereinto inserted, or therein distributed.

Fig. 5.

aaaa A Lobe of a Gourd-seed.

cccc The greater Branches.

ee The Sub-divisions and Inosculation of the lesser.

Fig.

Fig 5. 00.

AA A great white *Lupine*.

aa The *Navel-Fibres* which strike from the *Ramulets* of the *seed-Branch*, into the *Lobes*.

ab The production of the *Navel-Fibre* into the *Radicle* (*b.*)

c The *Plume*.

bc The *Pith*.

aeeee The distribution of the *Navel-Fibre* in the *Lobes*; all becoming the *seminal Root*, describ'd in the first Chapter.

Fig. 6.

aaaa A Slice of the Root of a Tree.

cccc The Cortical Body or Barque.

e The Pith.

The black Pieces are the Shootings of the *Lignous Body*.

The Specks therein are its *Pores*.

The White Pieces are the *Insertions* of the Cortical Body.

Fig.

Fig. 7.

*Showeth the Root of Berbery in the
Traverse Cut.*

*aaa The Cortical Body or Barque.
The white Lines are the Insertions.
The Black Specks are the Pores of
the Lignous Body.*

Fig. 8.

*aaaa The Cortical Body as appear-
ing in a Turnep cut athwart.*

O 3

ac

acdacd The *Lignous Body*, or the several Shoots thereof represented in their Ranks, by the black Lines; the Pricks made along the Lines being the Terminations of the said Shoots or Fibres; not visible except in a thin slice, or after the Surface of the *Turnep*, being cut, is well dried.

cccc The *Cortical Body* inserted betwixt the Shootings of the *Lignous*: or the *Pith*.

ab ab A piece of the *Cortical Body* taken off, that its own Insertions (*eeee*) and the Osculations of the *Lignous* may be seen; which is best done after the Insertions are a little dried and shrunk.

Fig.

*The Appearance of divers Roots, in
their Elder estate, as ex. gr.
of a Columbine.*

Fig. 9.

he Fibrous parts of the *Root*,
where the *Lignous Body* stands
Central ; the Pores whereof are
represented by the black Specks.

10. The *Root* cut a little higher,
where the *Cortical Body* some-
times appears only once inserted.

11. The *Root* cut higher with the
Insertions in some number.

12. The Insertions still more nu-
merous.

13. The *Pith* (a) now begun, the
said Insertions being collected
in the Center.

14. The *Pith* (a) more amplified.

Fig. 15.

Sheweth a small piece of the Trunk of Burdock.

a The just size thereof to the naked Eye.

aaaa The appearance of it through a *Microscope*.

lll The Inserted *Cortical Body*.

ccc The outmost shooting of the *Lignous Body* distributed into the Leaves.

ee b b t t The inner Shootings or Fibres distributed to the Branches.

The Black Specks are their Pores, which, through a *Microscope* are fairly visible in them all.

Fig.

Fig. 16.

aaaa The Slice of a Trunk of divers years growth.

cccc The *The Cortical Body*, or *Barque*.

e The *Pith*.

The white Lines are the Insertions of the *Cortical Body* or *Barque*.

The Black Lines are the *lignous Body*.

The several Shootings thereof betwixt the black Circles shew the Annuall Rings.

Fig.

Fig. 17.

*Sheweth a small piece of Oak cut a-
thwart.*

b The just bigness of it, as it ap-
peareth to the naked eye.

bbbb The appearance thereof
through a *Microscope*.

aaaa The greater Insertions visible
to the bare eye.

The white Lines are the smaller In-
sertions only visible by the *Mi-
croscope*.

cccccc The greater Pores visible to
the bare eye.

eeeeee The middle sized.

The black Spots are the smallest of
all, and both these latter visible
only through the *Microscope*.

c The *Pith* of every great Pore.

Fig.

Fig. 18.

aaaa A piece of the Leaf of a Table.

bbbb The *lignous Body* with its Pores running by the length of the Trunk.

cccc The Insertions of the *Cortical Body*, with the Tract of their Pores running directly cross to those of the *lignous*, viz. by the Diameter or breadth of the Trunk.

Fig.

Fig. 19.

*A Slice of a younger Trunk of a
Burdock.*

cccc The utmost Shootings of the
lignous Body contiguous to the
Skin; wholly distributed into
the outer Leaves.

eeee The middle Shootings running
chiefly into the lower *Germens*.

et et &c. The inner Shootings be-
longing to the higher *Germens*.

a The *Pith*,

Fig.

*The various Disposure,
Size and Figure of the
Fibres in the Stalk of a
Leaf.*

Fig.

- 20 In *Endive* thus
- 21 *Coltsfoot.*
- 22 *Cycory.*
- 23 *Ivy.*
- 24 *Asarabacca.*
- 25 *Mint.*
- 26 *Dock.*
- 27 *Borage.*
- 28 *Mullen.*
- 29 *Cabbage.*

F I N I S.

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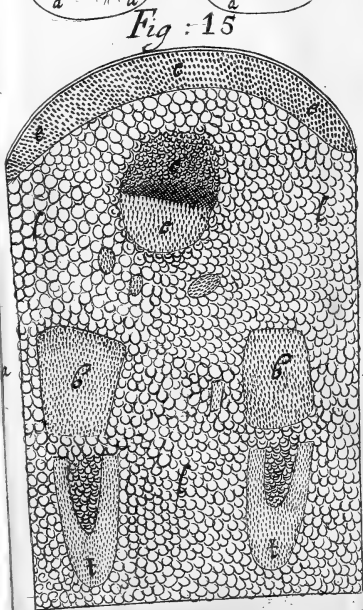
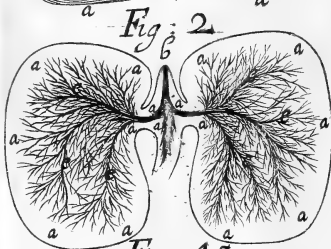
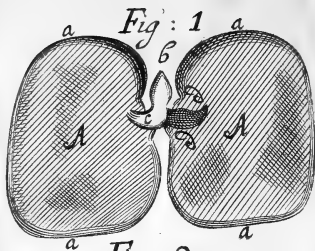




Fig: 19



Fig: 16



Fig: 3



Fig: 5



Fig: 4



Fig: 1

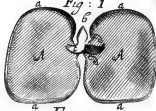


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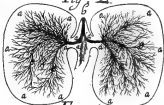


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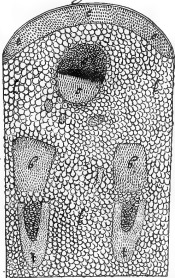




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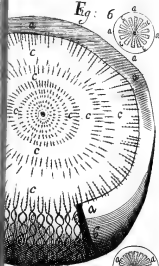


Fig: 7



Fig: 8

Fig: 6



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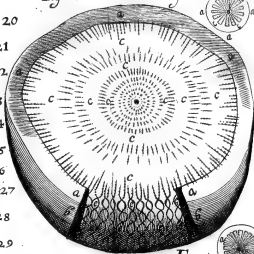
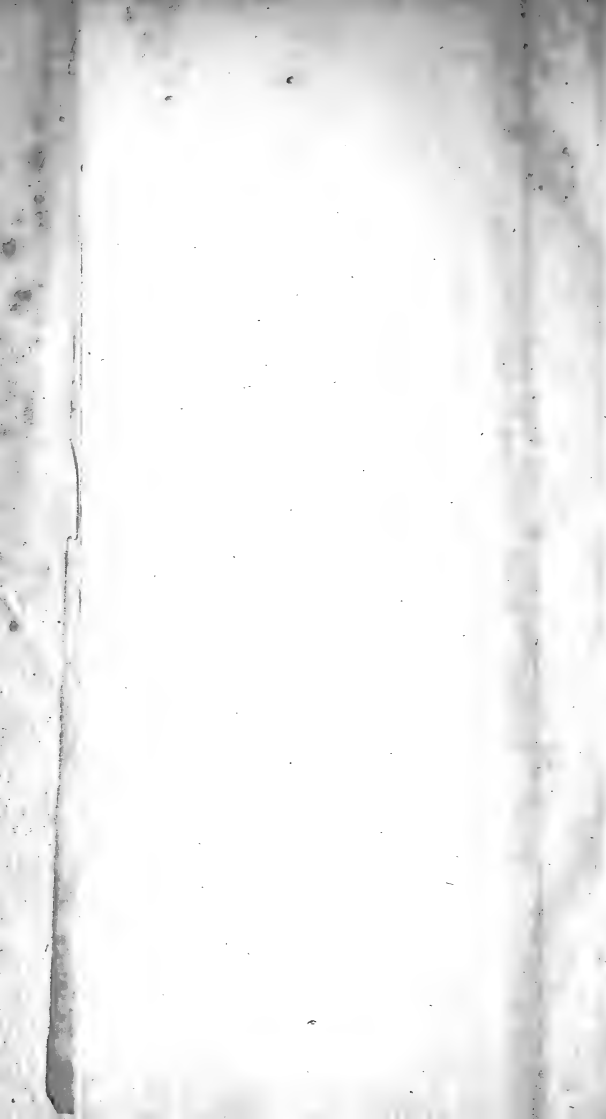


Fig: 7





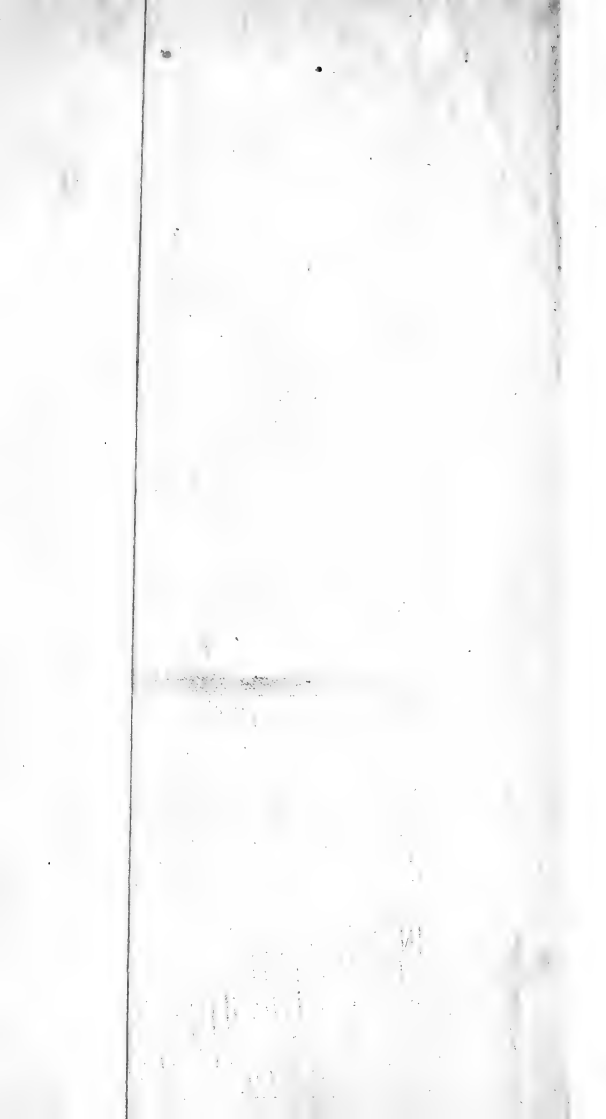




Fig: 9



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Fig: 17

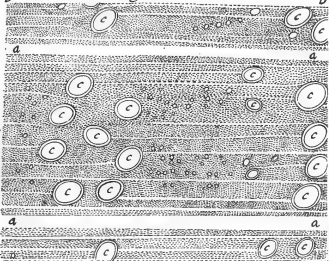


Fig: 18

